

JANUARY 09, 2025

WTA ARCHITECTS



DOW GARDENS WELCOME CENTER

BID PACK NO.3
BID DOCUMENTS

MIDLAND, MICHIGAN

ARCHITECT'S PROJECT NO. 2022022

WTAARCH.COM

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NOT APPLICABLE

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END OF SECTION 000110

DOCUMENT 003126 - GEOTECHNICAL DATA

1.1 GEOTECHNICAL DATA

- A. This Document with its referenced attachments is part of the Procurement and Contracting Requirements for Project. They provide Owner's information for Bidders' convenience and are intended to supplement rather than serve in lieu of Bidders' own investigations. They are made available for Bidders' convenience and information but are not a warranty of existing conditions. This Document and its attachments are not part of the Contract Documents.
- B. A geotechnical investigation report for Project, prepared by McDowell & Associates, dated May 1, 2024, is available for viewing as appended to this Document.

END OF DOCUMENT 003126

McDowell & Associates

Geotechnical, Environmental & Hydrogeological Services • Materials Testing & Inspection

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May 1, 2024

Herbert H. and Grace A. Dow Foundation
1081 Main Street
Midland, Michigan 48301

Job No. 24-64554

Attention: Ms. Jenee Velasquez

Subject: Soils Investigation
Proposed Dow Gardens Welcome Center
1809 Eastman Avenue
Midland, Michigan

Dear Ms. Velasquez:

In accordance with your request, we have made a Soils Investigation at the subject project.

Eleven (11) Soil Test Borings, designated as 1 through 11, were performed at the locations you required. The approximate locations of the borings are shown on the Soil Boring Location Plan which accompanies this report. The borings were advanced to depths of eight feet six inches (8'6") and twenty-five feet six inches (25'6") below the existing ground surface at the boring locations.

Soil descriptions, groundwater observations, and the results of field and laboratory tests are to be found on the accompanying Logs of Soil Test Borings and summary sheet of Sieve Analysis.

The borings encountered eight inches (8") to one foot one inch (1'1") of topsoil, asphalt pavement and aggregate fill soils consisting of brown sand and gravel, one foot ten inches (1'10") to five feet (5') of medium compact to compact brown clayey silt and fine sand to fine sand and firm brown clayey silt, followed by stiff to very stiff brown to blue silty clay which were found throughout the remainder of the borings. Three inch (3") to four inch (4") thick asphalt pavement was found at Borings 1, 2, 4 and 6 through 11.

Soils descriptions and depths shown on the boring logs are approximate indications of change from one soil type to another and are not intended to represent an area of exact geological change or stratification. Also, the site shows signs of modification which could indicate fill and soil conditions different from those encountered at the boring locations.

Water was encountered in Borings 1, 2, 4, 5, 6 and 8 through 11 at depths ranging from nine inches (9") to two feet (2') below the existing ground surface. Water was measured upon completion of the drilling operation in these borings at depths ranging from two feet (2') to three feet (3'). No water was encountered in Borings 3 and 7. It should be noted that short-term groundwater observations may not provide a reliable indication of the depth of the water table. In clay soils this is due to the slow rate of infiltration of water into the borehole as well as the potential for water to

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become trapped in overlying layers of granular soils during periods of heavy rainfall. Water levels in granular soils fluctuate with seasonal and climatic changes as well as the amount of rainfall in the area immediately prior to the measurements. It should be expected that groundwater level fluctuations may occur on a seasonal basis and that seams of water-bearing sands or silts could be found within the various clay strata at the site.

Standard Penetration Tests were made during sampling using an automatic hammer. These tests indicate the native soils at the site have poor to good strengths and densities. Tests taken at a depth of two feet six inches (2'6") gave results ranging from 5 to 12 blows per foot. The five-foot (5') test values varied from 4 to 8 blows per foot. At a depth of seven feet six inches (7'6"), the results ranged from 6 to 9 blows per foot. At ten feet (10') and below, penetration indices varied from 4 to 13 blows per foot.

It is understood that a new welcoming center consisting of buildings and outdoor canopy areas will be constructed in the vicinity of Borings 1 through 8. Buildings will be one story slab-on-grade structures. Maximum building and canopy column loads are anticipated to be 60 kips and maximum wall loads on the order of 1 kip per foot. It appears that new pavements may be required for drives and parking areas. We have assumed the pavements will support mostly automobile traffic. It is not known if the existing pavements at the site will be incorporated into the new parking areas and drives.

Based on the project information provided and the results of field and laboratory tests, it is believed that the new structures and canopies could be supported by conventional spread or strip footings or piers. All exterior footings or piers or foundations in unheated areas should be constructed at, or below, a minimum frost penetration depth of three feet six inches (3'6") below finished grade. All interior and exterior load-bearing footings or piers should extend through non-engineered fill soils, soils containing a significant amount of organic substances, or excessively weak soils. All strip footings should be continuously reinforced in order to minimize the noticeable effects of differential settlement.

Footings or piers constructed at the following boring locations could be proportioned for the design soil pressures listed in the table below:

<u>Boring</u>	<u>Depth</u>	<u>Soil Pressure (psf)</u>
1	1'6" to 2'6"	2000
	3'0" to 7'6"	2500
	8'0" to 10'0"	1500
2	1'6" to 6'0"	2500
	6'6" to 10'0"	3000
3	1'6" to 4'0"	2000
	4'6" to 10'0"	3000
4	1'6" to 6'0"	2500
	6'6" to 10'0"	3000

<u>Boring</u>	<u>Depth</u>	<u>Soil Pressure (psf)</u>
5	1'6" to 8'6"	2500
	9'0" to 10'0"	3500
6	1'6" to 10'0"	2500
7	1'6" to 3'0"	2500
	3'6" to 5'6"	3000
	6'0" to 7'0"	2000
	7'6" to 10'0"	1500
8	1'6" to 10'0"	2500

Based on the above chart, it appears that lower strength soils may be encountered in the vicinity of Borings 1 and 7 which may necessitate larger than normal footing or pier sizes at or below depths of seven feet six inches (7'6") and eight feet (8').

It should be noted that footing or pier excavations may be near, or below, the level at which water was encountered in Borings 1, 2, 4, 5, 6 and 8. Depending upon the depth of the footings or piers relative to the existing ground surface and the actual conditions at the time of construction, it may be necessary to depress the water table in these locations to allow for footings or piers to be constructed. It is sometimes possible to construct strip footings or piers a foot or so below the water table in coarse granular soils using a rapid sequence of excavation and placement of concrete. If this is not possible, it may be necessary to use special dewatering techniques to depress the water table in the vicinity of this boring. Extreme care must be exercised during the dewatering operation if any nearby structures or utilities are sensitive to settlement. Care must be taken to minimize the removal of soil fines during the pumping operations.

Where footings or piers are to be constructed next to existing buildings, the new footings or piers should be constructed at least as deep as the existing footings. Where new footings or piers are to be constructed to greater depths than the existing footings, it may be necessary to underpin the existing footing to avoid undermining the structure.

If the possibility of more than normal differential movement can be tolerated, then new slab-on-grade or slab-supporting backfill could be placed at or near the present grade. If any existing asphalt or concrete pavement is found within the proposed structure areas, it should be either removed or thoroughly broken. If any existing underground utilities are found within the planned structure areas, they should be removed and properly backfilled or grouted in place. Any surficial topsoil, highly organic, soft, loose, or obviously objectionable material should be removed and the subgrade thoroughly proof-compacted with heavy, rubber-tired equipment. If during the proof-compaction operation, areas are found where the soils yield excessively, the yielding materials should be scarified, dried and recompacted or removed and replaced with engineered fill. Where fill or backfill is required to raise the subgrade for concrete floors, it is suggested that clean, well-graded granular soils be used. If clay material is utilized, it should be placed within 2% of its optimum moisture content. The fill should be deposited in horizontal lifts not to exceed nine inches

(9") in thickness with each lift being compacted uniformly to a minimum density of 95% of its maximum value as determined by the Modified Proctor Test (AASHTO T-180 or ASTM D-1557).

If the possibility of more than normal differential movement cannot be tolerated, then any existing fill material should be removed and replaced with engineered fill meeting the requirements outlined above or the floor slabs should be structurally supported.

If any existing structures or below grade structures are found, they should be entirely removed from the proposed structure areas. Buried utilities should be removed or grouted in place. In lawn or parking areas, any existing structure foundations should be removed to a minimum depth of three feet (3') below finished grade. The resulting excavation should be backfilled with engineered fill meeting the requirements outlined above. If any existing basement floors are located outside of the proposed structures, then they can remain but should be broken up.

It appears that the subgrade soils consist of silt and fine sand soils. We would expect the silt soils to have low California Bearing Ratios (CBRs) on the order of 3% and a modulus of subgrade reaction of about one hundred pounds per cubic inch (100pci). It appears the silt soils have a high percentage of silt-size particles which would indicate they would tend to have a severe frost heave potential.

Based on the above estimated CBR value, we have made the following pavement analysis. The site soils appear to be very susceptible to frost heave. Consequently, it is suggested that in areas of automobile and light truck traffic, three inches (3") of asphalt with eight inches (8") of high quality, well-graded granular base course be used. In the areas subject to a considerable amount of truck traffic, it is recommended that the asphalt thickness be increased by a minimum of one-and-one-half inches (1½"). In the areas to be paved, the site should be prepared in a manner similar to that recommended above. In addition, the subgrade should be reworked until approximately the upper one foot (1') of the subgrade is compacted to at least 95% of its maximum dry density as determined by the Modified Proctor Test. It is recommended as a minimum that stub drains be provided at the storm sewer catch basins to provide some drainage for the pavement base. The subgrade should be properly sloped to allow drainage of surface water. Eight inches (8") of concrete pavement should be used in the dumpster area and other intensive truck wheel load areas. Edge drains should be installed in shallow groundwater areas (shallower than 18") or in watered landscaped areas such as in the vicinity of Borings 1, 2, 4, 5, 6, 8, 9, 10 and 11.

Existing pavement materials blanketing some areas of the site were not utilized in our pavement design. These materials may still have a vehicular bearing capacity, and it may be possible to incorporate these into the recommended pavement sections. If it is desired to consider these existing surfacing materials, it is suggested that an additional pavement study be performed to ascertain the quality and usability of these materials.

Experience indicates that the actual subsoil conditions at the site could vary from those found at the test borings made at specific locations. It is, therefore, essential that McDowell & Associates be notified of any variation of soil conditions to determine their effects on the recommendations presented in this report. The evaluations and recommendations presented in this report have been formulated on the basis of reported or assumed data relating to the proposed project. Any

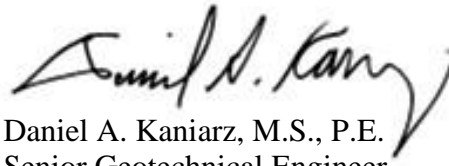
significant change in this data in the final design plans should be brought to our attention for review and evaluation with respect to the prevailing subsoil conditions.

It is recommended that the services of McDowell & Associates be engaged to observe the soils in the footing excavations prior to concreting in order to test the soils for the required bearing capacities. Testing should also be performed to check that suitable materials are being used for controlled fills and that they are properly placed and compacted.

If you have any questions or if we can be of any further service, please feel free to call.

Very truly yours,

McDOWELL & ASSOCIATES

A handwritten signature in black ink, appearing to read "Daniel A. Kaniarz". The signature is written in a cursive style with a large, sweeping flourish at the end.

Daniel A. Kaniarz, M.S., P.E.
Senior Geotechnical Engineer

DAK/mr



McDOWELL & ASSOCIATES
 Geotechnical, Environmental, & Hydrogeologic Services
 21355 Hatcher Avenue • Ferndale, MI 48220
 Phone: (248) 399-2066 • Fax: (248) 399-2157

LOG OF SOIL BORING NO. 1

PROJECT Soils Investigation

JOB NO. 24-64554

Proposed Dow Gardens Welcome Center

LOCATION 1809 Eastman Avenue

SURFACE ELEV. _____ **DATE** 4/16/2024

Midland, Michigan

Sample & Type	Depth	Legend	SOIL DESCRIPTION	Penetration Blows for 6"	Moisture %	Natural Wt. P.C.F.	Dry Den Wt. P.C.F.	Unc. Comp. Strength PSF.	Str. %
			0'3" ASPHALT						
	1		0'8" Moist brown SAND & GRAVEL, aggregate fill						
A	2		Medium compact moist to wet brown fine SAND with trace of silt	2					
UL				2	22.7	123		2690	
	3			3			*	(2500)	
	4			3					
B	5		Stiff moist brown sandy CLAY	2					
UL				3	24.8	119			
	6			3			*	(2500)	
	7			2					
C	8			3	25.1	120		3330	
UL				3			*	(3000)	
	9								
D	10		9'0" Medium compact wet brown clayey SILT and fine SAND	2					
UL				2	22.3	123		950	
	11			2					
	12								
	13								
	14								
E	15			2					
UL				3					
	16			5					
	17								
	18		Stiff moist blue silty CLAY with sand and pebbles						
	19								
F	20			3					
UL				3					
	21			5					
	22								
	23		Notes:						
			(1) Used automatic hammer.						
			(2) Patched boring upon completion with cold patch asphalt.						
G	24			2					
UL	25			5					
				6					

TYPE OF SAMPLE
 D. - DISTURBED
 U.L. - UNDIST. LINER
 S.T. - SHELBY TUBE
 S.S. - SPLIT SPOON
 R.C. - ROCK CORE
 () - PENETROMETER

REMARKS: *Calibrated Penetrometer

Standard Penetration Test - Driving 2" OD Sampler 1' With
 140# Hammer Falling 30"; Count Made at 6" Intervals

GROUND WATER OBSERVATIONS

G.W. ENCOUNTERED AT 1 FT. 6 INS.
 G.W. ENCOUNTERED AT FT. INS.
 G.W. AFTER COMPLETION 3 FT. 0 INS.
 G.W. AFTER HRS. FT. INS.
 G.W. VOLUMES Medium



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LOG OF SOIL
 BORING NO. 2

PROJECT Soils Investigation

JOB NO. 24-64554

Proposed Dow Gardens Welcome Center

LOCATION 1809 Eastman Avenue

SURFACE ELEV. _____ DATE 4/19/2024

Midland, Michigan

Sample & Type	Depth	Legend	SOIL DESCRIPTION	Penetration Blows for 6"	Moisture %	Natural Wt. P.C.F.	Dry Den Wt. P.C.F.	Unc. Comp. Strength PSF.	Str. %
	1		0'3" ASPHALT						
			0'8" Moist brown SAND & GRAVEL, aggregate fill						
A	2		Compact moist to wet brown fine SAND with trace of silt	4					
UL		5		13.8	123				
	3			5					
	4		3'0" Stiff moist brown silty CLAY with moist to wet silt seams	6					
B	5			3					
UL				3	26.5	119	*	2850	(2500)
	6		Stiff moist brown silty CLAY with moist to wet silt seams						
C	7			2					
UL				4	24.8	123		4020	
	8		Stiff moist brown silty CLAY with moist to wet silt seams	5			*	(4000)	
	9								
D	10			3					
UL			4	24.5	124				
	11		13'0" Stiff moist blue silty CLAY with sand and pebbles	4			*	(3500)	
	12								
	13								
	14		Stiff moist blue silty CLAY with sand and pebbles						
E	15			2					
UL				3					
	16		Stiff moist blue silty CLAY with sand and pebbles	4					
	17								
	18								
	19		Stiff moist blue silty CLAY with sand and pebbles						
F	20			2					
UL				3					
	21		Stiff moist blue silty CLAY with sand and pebbles	3					
	22								
	23								
	24		Stiff moist blue silty CLAY with sand and pebbles						
G	25			2					
UL				3					
	25'6"		4						

Notes:

(1) Used automatic hammer.

(2) Patched boring upon completion with cold patch asphalt.

TYPE OF SAMPLE
 D. - DISTURBED
 U.L. - UNDIST. LINER
 S.T. - SHELBY TUBE
 S.S. - SPLIT SPOON
 R.C. - ROCK CORE
 () - PENETROMETER

REMARKS:

*Calibrated Penetrometer

Standard Penetration Test - Driving 2" OD Sampler 1' With
 140# Hammer Falling 30"; Count Made at 6" Intervals

GROUND WATER OBSERVATIONS

G.W. ENCOUNTERED AT 1 FT. 6 INS.
 G.W. ENCOUNTERED AT FT. INS.
 G.W. AFTER COMPLETION 2 FT. 0 INS.
 G.W. AFTER HRS. FT. INS.
 G.W. VOLUMES Medium



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LOG OF SOIL
 BORING NO. 3

PROJECT Soils Investigation

JOB NO. 24-64554

Proposed Dow Gardens Welcome Center

LOCATION 1809 Eastman Avenue

SURFACE ELEV. _____ DATE 4/23/2024

Midland, Michigan

Sample & Type	Depth	Legend	SOIL DESCRIPTION	Penetration Blows for 6"	Moisture %	Natural Wt. P.C.F.	Dry Den Wt. P.C.F.	Unc. Comp. Strength PSF.	Str. %
	1		Moist dark brown sandy TOPSOIL						
A	2		Medium compact moist brown fine SAND with trace of silt	2					
UL	3			3	23.7	110			
	4		Firm moist brown clayey SILT	2					
	5			3					
B	6		Compact moist brown clayey SILT & fine SAND	3					
UL	7			4	26.7	117		1385	
	8			4					
C	9		Stiff moist blue silty CLAY with moist silt seams	2					
UL	10			4	26.1	122		3090	
	11			5			*	(3500)	
	12								
D	13		Stiff moist blue silty CLAY with sand and pebbles	2					
UL	14			4	26.8	122		4095	
	15			4			*	(4000)	
	16								
	17								
E	18		Stiff moist blue silty CLAY with sand and pebbles	2					
UL	19			2					
	20			4					
	21								
F	22		Stiff moist blue silty CLAY with sand and pebbles	2					
UL	23			3					
	24			3					
	25								
G	26		Stiff moist blue silty CLAY with sand and pebbles	2					
UL	27			4					
	28			4					

Note: Used automatic hammer.

TYPE OF SAMPLE
 D. - DISTURBED
 U.L. - UNDIST. LINER
 S.T. - SHELBY TUBE
 S.S. - SPLIT SPOON
 R.C. - ROCK CORE
 () - PENETROMETER

REMARKS: *Calibrated Penetrometer

Standard Penetration Test - Driving 2" OD Sampler 1' With
 140# Hammer Falling 30": Count Made at 6" Intervals

GROUND WATER OBSERVATIONS

G.W. ENCOUNTERED AT FT. INS.
 G.W. ENCOUNTERED AT FT. INS.
 G.W. AFTER COMPLETION None FT. INS.
 G.W. AFTER HRS. FT. INS.
 G.W. VOLUMES



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 21355 Hatcher Avenue • Ferndale, MI 48220
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LOG OF SOIL BORING NO. 4

PROJECT Soils Investigation

JOB NO. 24-64554

Proposed Dow Gardens Welcome Center

LOCATION 1809 Eastman Avenue

SURFACE ELEV. _____ **DATE** 4/16/2024

Midland, Michigan

Sample & Type	Depth	Legend	SOIL DESCRIPTION	Penetration Blows for 6"	Moisture %	Natural Wt. P.C.F.	Dry Den Wt. P.C.F.	Unc. Comp. Strength PSF.	Str. %
	1		0'3" ASPHALT						
			1'0" Moist brown SAND & GRAVEL, aggregate fill						
A	2		Compact moist to wet brown SILT & fine SAND	6					
UL				5	14.2	126			
	3			5					
				6					
	4		3'6" Stiff moist brown silty CLAY with moist to wet silt seams						
B	5			3					
UL				3	30.2	110	*	(2500)	
	6			3					
	7		Stiff moist brown silty CLAY with moist to wet silt seams						
C	8			3					
UL				4	25.7	121		3305	
	9			5			*	(3500)	
	10		13'0" Stiff moist blue silty CLAY with sand and pebbles						
D	11			3					
UL				4	20.0	127			
	12			6			*	(4000)	
	13		Stiff moist blue silty CLAY with sand and pebbles						
	14								
E	15			2					
UL				3					
	16								
	17								
	18								
	19		Notes: (1) Used automatic hammer. (2) Patched boring upon completion with cold patch asphalt.						
F	20			2					
UL				4					
	21			4					
	22								
	23								
	24								
G	25		25'6"	3					
UL				4					
				5					

TYPE OF SAMPLE
 D. - DISTURBED
 U.L. - UNDIST. LINER
 S.T. - SHELBY TUBE
 S.S. - SPLIT SPOON
 R.C. - ROCK CORE
 () - PENETROMETER

REMARKS: *Calibrated Penetrometer

Standard Penetration Test - Driving 2" OD Sampler 1' With
 140# Hammer Falling 30": Count Made at 6" Intervals

GROUND WATER OBSERVATIONS

G.W. ENCOUNTERED AT 1 FT. 6 INS.
 G.W. ENCOUNTERED AT FT. INS.
 G.W. AFTER COMPLETION 3 FT. 0 INS.
 G.W. AFTER HRS. FT. INS.
 G.W. VOLUMES Medium



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LOG OF SOIL
 BORING NO. 5

PROJECT Soils Investigation

JOB NO. 24-64554

Proposed Dow Gardens Welcome Center

LOCATION 1809 Eastman Avenue

SURFACE ELEV. _____ DATE 4/16/2024

Midland, Michigan

Sample & Type	Depth	Legend	SOIL DESCRIPTION	Penetration Blows for 6"	Moisture %	Natural Wt. P.C.F.	Dry Den Wt. P.C.F.	Unc. Comp. Strength PSF.	Str. %
	1		Moist dark brown sandy TOPSOIL						
	1'1"								
A	2		Compact moist to wet brown fine SAND with trace of silt	2	18.2	125			
UL	3			5					
	6			6					
	3'6"			5					
	4		Compact wet brown clayey SILT & fine SAND	2	13.1	126		2660	
B	5			3					
UL	6			4					
	6'0"						*	(2500)	
	7		Stiff moist brown silty CLAY	2	23.7	123			
C	8			3					
UL	9			4					
	8'6"						*	(2500)	
	10		Very stiff moist brown silty CLAY with moist to wet silt seams	3	22.9	124		4600	
D	11			6					
UL	12			7					
	13'0"						*	(5500)	
	14		Stiff moist blue silty CLAY with sand and pebbles	2					
E	15			2					
UL	16			4					
	17								
	18								
	19		Note: Used automatic hammer.	2					
F	20			4					
UL	21			4					
	22								
	23								
	24			2					
G	25			3					
UL	25'6"			3					

TYPE OF SAMPLE
 D. - DISTURBED
 U.L. - UNDIST. LINER
 S.T. - SHELBY TUBE
 S.S. - SPLIT SPOON
 R.C. - ROCK CORE
 () - PENETROMETER

REMARKS: *Calibrated Penetrometer

Standard Penetration Test - Driving 2" OD Sampler 1' With
 140# Hammer Falling 30": Count Made at 6" Intervals

GROUND WATER OBSERVATIONS

G.W. ENCOUNTERED AT 1 FT. 6 INS.
 G.W. ENCOUNTERED AT 12 FT. 6 INS.
 G.W. AFTER COMPLETION 2 FT. 6 INS.
 G.W. AFTER HRS. FT. INS.
 G.W. VOLUMES Medium



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LOG OF SOIL
 BORING NO. 6

PROJECT Soils Investigation

JOB NO. 24-64554

Proposed Dow Gardens Welcome Center

LOCATION 1809 Eastman Avenue

SURFACE ELEV. _____ DATE 4/16/2024

Midland, Michigan

Sample & Type	Depth	Legend	SOIL DESCRIPTION	Penetration Blows for 6"	Moisture %	Natural Wt. P.C.F.	Dry Den Wt. P.C.F.	Unc. Comp. Strength PSF.	Str. %
			0'3" ASPHALT						
	1		0'9" Moist brown SAND & GRAVEL, aggregate fill						
A	2		Compact wet brown fine SAND with trace of silt	4					
UL	3			4	19.7	118			
	4			4					
				5					
B	5		4'6"	3					
UL	6			3	25.7	122	*	(2500)	
				3					
C	7		Stiff moist variegated silty CLAY with moist to wet silt seams	2					
UL	8			3	25.3	122	*	(3000)	
				5					
	9		13'0"						
D	10			3					
UL	11			3	22.1	128	*	2120	
				3				(2500)	
	12		Stiff moist blue silty CLAY with sand and pebbles						
	13								
	14								
E	15			2					
UL	16			3					
				4					
	17		25'6"						
	18								
	19								
F	20			3					
UL	21		4						
			4						
	22		Notes:						
	23			(1) Used automatic hammer.					
	24			(2) Patched boring upon completion with cold patch asphalt.					
G	25			3					
UL				5					
				6					

TYPE OF SAMPLE
 D. - DISTURBED
 U.L. - UNDIST. LINER
 S.T. - SHELBY TUBE
 S.S. - SPLIT SPOON
 R.C. - ROCK CORE
 () - PENETROMETER

REMARKS: *Calibrated Penetrometer

Standard Penetration Test - Driving 2" OD Sampler 1' With
 140# Hammer Falling 30": Count Made at 6" Intervals

GROUND WATER OBSERVATIONS

G.W. ENCOUNTERED AT 0 FT. 9 INS.
 G.W. ENCOUNTERED AT FT. INS.
 G.W. AFTER COMPLETION 2 FT. 6 INS.
 G.W. AFTER HRS. FT. INS.
 G.W. VOLUMES Medium



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LOG OF SOIL
 BORING NO. 7

PROJECT Soils Investigation

JOB NO. 24-64554

Proposed Dow Gardens Welcome Center

LOCATION 1809 Eastman Avenue

SURFACE ELEV. _____ DATE 4/16/2024

Midland, Michigan

Sample & Type	Depth	Legend	SOIL DESCRIPTION	Penetration Blows for 6"	Moisture %	Natural Wt. P.C.F.	Dry Den Wt. P.C.F.	Unc. Comp. Strength PSF.	Str. %
	1		0'4" ASPHALT						
			0'10" Moist brown SAND & GRAVEL, aggregate fill						
A	2		Medium compact moist brown fine SAND with trace of silt	2					
UL	3			3	24.4	127		2470	
	3			3			*	(2500)	
	4			4					
B	5		Stiff moist brown silty CLAY with moist silt seams	2					
UL	5			4	25.0	125			
	6			5			*	(3500)	
	6								
C	7		8'6" Firm moist blue silty CLAY	2					
UL	8			3	24.9	122		3765	
	8			5			*	(3500)	
	9								
D	10		13'0" Stiff moist blue silty CLAY with sand and pebbles	1					
UL	10			2	21.6	127			
	11			2			*	(1500)	
	12								
E	15		Notes:	2					
UL	15			3					
	16			3					
	17								
F	20		(1) Used automatic hammer.	3					
UL	20			3					
	21			5					
	22								
G	24		(2) Patched boring upon completion with cold patch asphalt.	2					
UL	24			5					
	25			5					
	25								

TYPE OF SAMPLE
 D. - DISTURBED
 U.L. - UNDIST. LINER
 S.T. - SHELBY TUBE
 S.S. - SPLIT SPOON
 R.C. - ROCK CORE
 () - PENETROMETER

REMARKS: *Calibrated Penetrometer

Standard Penetration Test - Driving 2" OD Sampler 1' With
 140# Hammer Falling 30": Count Made at 6" Intervals

GROUND WATER OBSERVATIONS

G.W. ENCOUNTERED AT FT. INS.
 G.W. ENCOUNTERED AT FT. INS.
 G.W. AFTER COMPLETION FT. INS.
 G.W. AFTER HRS. FT. INS.
 G.W. VOLUMES None



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LOG OF SOIL
 BORING NO. 8

PROJECT Soils Investigation

JOB NO. 24-64554

Proposed Dow Gardens Welcome Center

LOCATION 1809 Eastman Avenue

SURFACE ELEV. _____ DATE 4/19/2024

Midland, Michigan

Sample & Type	Depth	Legend	SOIL DESCRIPTION	Penetration Blows for 6"	Moisture %	Natural Wt. P.C.F.	Dry Den Wt. P.C.F.	Unc. Comp. Strength PSF.	Str. %
	1		0'4" ASPHALT						
			0'8" Moist brown SAND & GRAVEL, aggregate fill						
A	2		Compact moist to wet brown fine SAND with trace of silt	6					
UL		6		13.2	119				
	3			5					
	4		3'0"	5					
B	5			2					
UL		3		26.1	122				
	6			4			*	(2500)	
C	7		Stiff moist brown silty CLAY with moist to wet silt seams	3					
UL		4		25.4	122			3780	
	8			5			*	(3500)	
	9		13'0"						
D	10			2					
UL		3		21.1	128			1985	
	11			3			*	(2000)	
	12		Stiff moist blue silty CLAY with sand and pebbles						
	13								
	14								
E	15		25'6"	2					
UL		4							
	16			5					
	17								
	18								
	19								
F	20			2					
UL		4							
	21			4					
	22		Notes:						
	23			(1) Used automatic hammer.					
	24			(2) Patched boring upon completion with cold patch asphalt.					
G	25			2					
UL		3							
		3							

TYPE OF SAMPLE
 D. - DISTURBED
 U.L. - UNDIST. LINER
 S.T. - SHELBY TUBE
 S.S. - SPLIT SPOON
 R.C. - ROCK CORE
 () - PENETROMETER

REMARKS: *Calibrated Penetrometer

Standard Penetration Test - Driving 2" OD Sampler 1' With
 140# Hammer Falling 30"; Count Made at 6" Intervals

GROUND WATER OBSERVATIONS

G.W. ENCOUNTERED AT 1 FT. 6 INS.
 G.W. ENCOUNTERED AT FT. INS.
 G.W. AFTER COMPLETION 2 FT. 0 INS.
 G.W. AFTER HRS. FT. INS.
 G.W. VOLUMES Medium



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LOG OF SOIL
 BORING NO. 9

PROJECT Soils Investigation

JOB NO. 24-64554

Proposed Dow Gardens Welcome Center

LOCATION 1809 Eastman Avenue

SURFACE ELEV. _____ DATE 4/19/2024

Midland, Michigan

Sample & Type	Depth	Legend	SOIL DESCRIPTION	Penetration Blows for 6"	Moisture %	Natural Wt. P.C.F.	Dry Den Wt. P.C.F.	Unc. Comp. Strength PSF.	Str. %
	1		0'4" ASPHALT						
			0'9" Moist brown SAND & GRAVEL, aggregate fill						
A	2		Compact moist to wet brown fine SAND with trace of silt	5					
UL	3			6	17.1	122			
	4			6					
				6					
B	5		4'0" Stiff moist brown silty CLAY with moist to wet silt seams	2					
UL	6			3	32.1	116	*	(2500)	
	7			4					
C	8		8'0"	3					
UL	9			4	24.5	---	*	(3000)	
	10			4					
	11								
	12								
	13								
	14								
	15								
	16								
	17								
	18								
	19								
	20								
	21								
	22								
	23								
	24								
	25								

Notes:

- (1) Used automatic hammer.
- (2) Patched boring upon completion with cold patch asphalt.

TYPE OF SAMPLE
 D. - DISTURBED
 U.L. - UNDIST. LINER
 S.T. - SHELBY TUBE
 S.S. - SPLIT SPOON
 R.C. - ROCK CORE
 () - PENETROMETER

REMARKS: *Calibrated Penetrometer

Standard Penetration Test - Driving 2" OD Sampler 1' With
 140# Hammer Falling 30": Count Made at 6" Intervals

GROUND WATER OBSERVATIONS

G.W. ENCOUNTERED AT 1 FT. 6 INS.
 G.W. ENCOUNTERED AT FT. INS.
 G.W. AFTER COMPLETION 2 FT. 6 INS.
 G.W. AFTER HRS. FT. INS.
 G.W. VOLUMES Medium



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LOG OF SOIL
 BORING NO. 10

PROJECT Soils Investigation

JOB NO. 24-64554

Proposed Dow Gardens Welcome Center

LOCATION 1809 Eastman Avenue

SURFACE ELEV. _____ DATE 4/19/2024

Midland, Michigan

Sample & Type	Depth	Legend	SOIL DESCRIPTION	Penetration Blows for 6"	Moisture %	Natural Wt. P.C.F.	Dry Den Wt. P.C.F.	Unc. Comp. Strength PSF.	Str. %
	1		0'3" ASPHALT						
			0'8" Moist brown SAND & GRAVEL, aggregate fill						
A	2		Compact moist to wet brown fine SAND with trace of silt	5					
UL	3			5	15.9	123			
	4			5					
	6			6					
B	5		3'6" Stiff moist brown silty CLAY with moist to wet silt seams	3					
UL	6			3	28.0	120	*	3375	
	8			5				(3000)	
C	7		8'0"	2					
UL	8			3	25.5	116	*	(2500)	
	9			3					
	10								
	11								
	12								
	13								
	14								
	15								
	16								
	17								
	18								
	19								
	20								
	21								
	22								
	23								
	24								
	25								

Notes:

- (1) Used automatic hammer.
- (2) Patched boring upon completion with cold patch asphalt.

TYPE OF SAMPLE
 D. - DISTURBED
 U.L. - UNDIST. LINER
 S.T. - SHELBY TUBE
 S.S. - SPLIT SPOON
 R.C. - ROCK CORE
 () - PENETROMETER

REMARKS: *Calibrated Penetrometer

Standard Penetration Test - Driving 2" OD Sampler 1' With
 140# Hammer Falling 30": Count Made at 6" Intervals

GROUND WATER OBSERVATIONS

G.W. ENCOUNTERED AT 1 FT. 0 INS.
 G.W. ENCOUNTERED AT FT. INS.
 G.W. AFTER COMPLETION 3 FT. 0 INS.
 G.W. AFTER HRS. FT. INS.
 G.W. VOLUMES Medium



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LOG OF SOIL
 BORING NO. 11

PROJECT Soils Investigation

JOB NO. 24-64554

Proposed Dow Gardens Welcome Center

LOCATION 1809 Eastman Avenue

SURFACE ELEV. _____ DATE 4/19/2024

Midland, Michigan

Sample & Type	Depth	Legend	SOIL DESCRIPTION	Penetration Blows for 6"	Moisture %	Natural Wt. P.C.F.	Dry Den Wt. P.C.F.	Unc. Comp. Strength PSF.	Str. %
	1		0'4" ASPHALT						
			0'9" Moist brown SAND & GRAVEL, aggregate fill						
A	2		Compact moist to wet brown fine SAND with trace of silt	3					
UL	3			3	21.1	117			
	4			3					
	4			3					
B	5		4'0" Firm moist brown silty CLAY	2					
UL	6			2	31.6	114	*	1610	
	6			2				(1500)	
C	7		6'0" Stiff moist brown silty CLAY with moist to wet silt seams	3					
UL	8			4	25.1	122	*	4095	
	8			6				(4000)	
	9								
	10								
	11								
	12								
	13								
	14								
	15								
	16								
	17								
	18								
	19								
	20								
	21								
	22								
	23								
	24								
	25								

Notes:

- (1) Used automatic hammer.
- (2) Patched boring upon completion with cold patch asphalt.

TYPE OF SAMPLE
 D. - DISTURBED
 U.L. - UNDIST. LINER
 S.T. - SHELBY TUBE
 S.S. - SPLIT SPOON
 R.C. - ROCK CORE
 () - PENETROMETER

REMARKS: *Calibrated Penetrometer

Standard Penetration Test - Driving 2" OD Sampler 1' With
 140# Hammer Falling 30": Count Made at 6" Intervals

GROUND WATER OBSERVATIONS

G.W. ENCOUNTERED AT 2 FT. 0 INS.
 G.W. ENCOUNTERED AT FT. INS.
 G.W. AFTER COMPLETION 3 FT. 0 INS.
 G.W. AFTER HRS. FT. INS.
 G.W. VOLUMES Medium

SIEVE ANALYSIS

<u>Boring</u>	<u>Sample</u>	<u>% Passing #4 Sieve</u>	<u>% Passing #10 Sieve</u>	<u>% Passing #40 Sieve</u>	<u>% Passing #100 Sieve</u>	<u>% Passing #200 Sieve</u>
2	A	100.0	100.0	94.2	20.3	8.0
4	A	100.0	100.0	98.8	56.0	33.2
5	A	100.0	100.0	94.9	14.3	4.1
	B	100.0	99.9	98.6	59.4	37.0
6	A	99.8	99.7	98.7	54.1	8.5
8	A	100.0	99.7	94.9	25.6	7.7
9	A	100.0	100.0	96.3	11.2	3.2
10	A	99.7	99.5	95.3	16.1	4.5
11	A	100.0	100.0	99.3	35.3	4.1

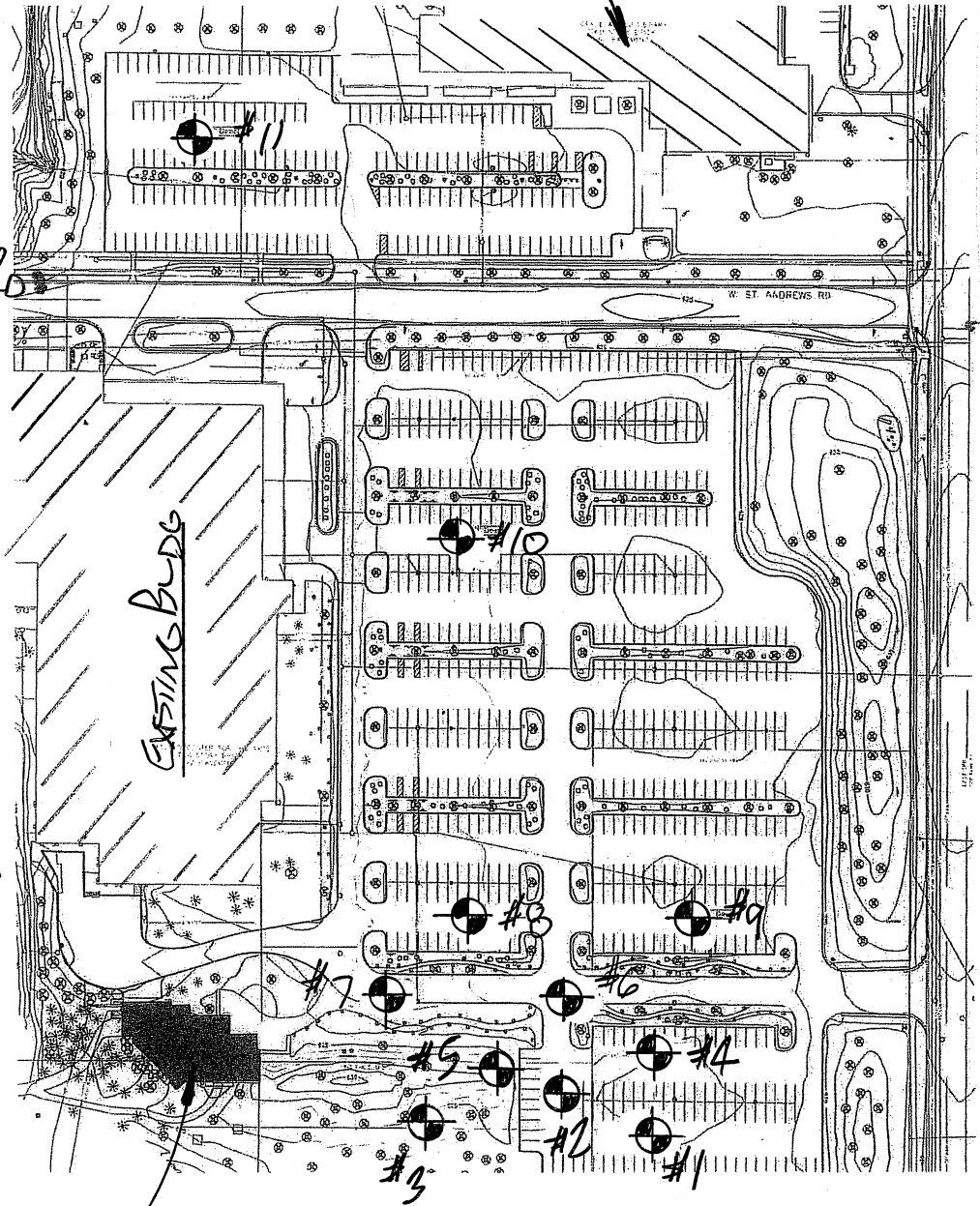
EXISTING BLDG

EASTMAN AVE.

ST. ANDREWS RD



NO SCALE



EXISTING BLDG

Soil Boring Location Plan

SECTION 005000 - AVAILABILITY OF ELECTRONIC FILES

PART 1 - GENERAL

1.1 POLICY

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

1.2 REQUEST PROCEDURE

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

NEW CONSTRUCTION FOR:
DOW GARDENS WELCOME CENTER
MIDLAND, MICHIGAN

PROJECT NO. 2022022

Firm Requesting Files:

Date: _____

Name: _____
Company: _____
Address: _____
City, State, Zip: _____

Phone: _____

Re: Letter of Authorization for Electronic File Transfers

Project Name: _____

WTA Project No.: _____

Dear Sir/Madam:

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

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

Fee: \$ _____ Drawings: _____

Signed: _____ Printed Name/Title: _____

To be Completed by WTA Architects, Inc.

Released (Signed By): _____	WTA Architects, Inc.
Printed Name/Title: _____	Date: _____

END OF SECTION 005000

SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 SUMMARY

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

1.2 PROJECT INFORMATION

- A. Project Identification: Dow Gardens Welcome Center, Architect Project No. 2022022.
 - 1. Project Location: 1809 Eastman Avenue, Midland, Michigan, 48640.
- B. Owner: Herbert H. and Grace A. Dow Foundation, 1018 W. Main Street, Midland, Michigan, 48640.
 - 1. Owner's Representative: Jenee Velasquez, Executive Director.
- C. Architect: WTA Architects, 100 S. Jefferson Ave, Ste 601, Saginaw, Michigan, 48607.
 - 1. Contact: Paul Haselhuhn, Project Architect, (989) 752-8107, phaselhuhn@wtaarch.com.
- D. Construction Manager: Spence Brothers, Inc., 203 S. Washington Avenue, Suite 360, Saginaw, Michigan, 48607.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of Project is defined by the Contract Documents and consists of the following:
 - 1. Construction of a new roughly 22,000 square foot welcome center and the surrounding site. Including all free-standing site elements as shown in these construction documents.

1.4 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
 - 1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
 - 2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

SECTION 012300 - ALTERNATES

PART 1 - GENERAL

1.1 SUMMARY

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

1.2 DEFINITIONS

- A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if the Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.
 - 1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
 - 2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternates into the Work. No other adjustments are made to the Contract Sum.

1.3 PROCEDURES

- A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.
 - 1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.
- B. Execute accepted alternates under the same conditions as other work of the Contract.
- C. Schedule: A schedule of alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

- A. Alternate No. 1: Glazing Type
 - 1. BASE BID: Install glass as indicated in drawings.
 - 2. ALTERNATE 1A: Omit GL-2 from all frames.
 - 3. ALTERNATE 1B: All glazing to be GL-2.

SECTION 01 2500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Procedural requirements for proposed substitutions.

1.02 RELATED REQUIREMENTS

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

1.03 DEFINITIONS

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

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

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

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

3.02 SUBSTITUTION PROCEDURES DURING PROCUREMENT

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

3.03 SUBSTITUTION PROCEDURES DURING CONSTRUCTION

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

2. Without a separate written request.

3.04 RESOLUTION

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

3.05 ACCEPTANCE

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

3.06 CLOSEOUT ACTIVITIES

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

END OF SECTION - 012500

NEW CONSTRUCTION FOR:
DOW GARDENS WELCOME CENTER
MIDLAND, MICHIGAN

PROJECT NO. 2022022

NEW CONSTRUCTION FOR:
DOW GARDENS WELCOME CENTER
MIDLAND, MICHIGAN

PROJECT NO. 2022022

SECTION 01 2500.01 - WTA SUBSTITUTION REQUEST FORM

SUBSTITUTION REQUEST NUMBER: _____ DATE SUBMITTED: _____
WTA PROJECT NUMBER _____ PROJECT NAME: _____

SPECIFIED ITEM

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

PROPOSED SUBSTITUTION

DESCRIPTION OF PROPOSED SUBSTITUTION: _____

PROPOSED MANUFACTURER: _____
ADDRESS: _____
WEBSITE: _____
PRODUCT / MODEL: _____
YEARS PRODUCT/MODEL HAS BEEN MANUFACTURED: _____
DIFFERENCES BETWEEN PROPOSED SUBSTITUTION AND SPECIFIED ITEM: _____

WILL PROPOSED SUBSTITUTION AFFECT OTHER PARTS OF WORK? NO YES
IF YES, EXPLAIN HOW: _____

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

NEW CONSTRUCTION FOR:
DOW GARDENS WELCOME CENTER
MIDLAND, MICHIGAN

PROJECT NO. 2022022

PROVIDE SPECIFIC DETAILS: _____

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

32.01

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

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

- DRAWINGS.
- SAMPLES.
- OTHER ITEMS: _____

SIGNATURE

THE UNDERSIGNED CERTIFIES:

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

CONTRACTOR / COMPANY: _____

SIGNED BY: _____ PRINTED NAME: _____

TITLE: _____

ADDRESS: _____

EMAIL: _____ PHONE: _____

NEW CONSTRUCTION FOR:
DOW GARDENS WELCOME CENTER
MIDLAND, MICHIGAN

PROJECT NO. 2022022

ARCHITECT'S RESPONSE

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

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

SIGNED BY: _____ PRINTED NAME: _____
ARCHITECT'S COMMENTS: _____

END OF SECTION - 012500.01

SECTION 01 4000 QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

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

1.2 DEFINITIONS

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

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

1.3 DELEGATED-DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1.4 CONFLICTING REQUIREMENTS

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

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

1.5 ACTION SUBMITTALS

- A. Delegated-Design Services Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit a statement signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

1.6 INFORMATIONAL SUBMITTALS

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

1.7 REPORTS AND DOCUMENTS

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

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

1.8 QUALITY ASSURANCE

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

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

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

1.9 QUALITY CONTROL

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

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

1.10 SPECIAL TESTS AND INSPECTIONS

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

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

3.2 REPAIR AND PROTECTION

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

END OF SECTION 01 4000

SECTION 01 45 16.02
DENSITY AND AGGREGATE TESTING

PART 1 - GENERAL

1.01 Work Included

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

1.02 References

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

1.03 Related Work

- A. Section 31 23 01 – Excavating, Filling, and Grading
- B. Section 32 11 16 – Granular Subbase
- C. Section 32 11 23 – Aggregate Base
- D. Section 32 12 16 – HMA Paving
- E. Section 33 11 00 – Water Main
- F. Section 33 31 00 – Sanitary Sewer
- G. Section 33 44 00 – Storm Sewers
- H. Section 33 46 16 – Underdrains

1.04 Quality Assurance and Quality Control

A. Soil and Aggregate Density Testing

1. The Owner is responsible for all onsite density testing on this project. The Owner has the right to determine which materials shall be tested and the frequency of testing.

B. Sand and Aggregate Gradation

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

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

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

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

1.05 Job Conditions

A. Access for Testing

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

B. Safety

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

PART 2 - PRODUCTS

2.01 Submittals

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

PART 3 - EXECUTION

3.01 Minimum Percent of Compaction for Aggregates

The following are a minimum percent compaction for typical items of work. Note: Higher percent compaction may be required for specific items of work, see Section 3.06.03.B of the Michigan Department of Transportation 2020 Standard Specifications for Construction for those items.

A. Original Ground

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

B. Cut Areas

Cuts requiring Sand Subbase	95 percent
Cuts not requiring Sand Subbase	95 percent

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

3.02 HMA Density

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

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

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

3.03 Testing Frequency

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

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

3.04 Compaction Efforts

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

END OF SECTION

SECTION 02 32 19
EXPLORATORY EXCAVATION

PART 1 - GENERAL

1.01 Work Included

This work consists of providing all labor, equipment, and materials required to excavate an exploratory hole to expose existing utilities to verify location, material, and size of pipe in accordance with Section 205 of the Michigan Department of Transportation 2020 Standard Specifications for Construction.

PART 2 - PRODUCTS

2.01 Materials

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

PART 3 - EXECUTION

3.01 Excavation

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

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

END OF SECTION

SECTION 02 41 13.13
PAVEMENT REMOVAL

PART 1 - GENERAL

1.01 Work Included

This work includes removal of an existing pavement, including streets, driveways, sidewalks, curb and/or gutter, and parking areas. For purposes of the work "pavement removal", pavement material may include HMA, concrete, brick, or any combination thereof, including any reinforcement materials.

PART 2 - PRODUCTS

Not Applicable

PART 3 - EXECUTION

3.01 Limits of Removal

Pavement shall be removed to the limits shown on the plans, or as directed by the Engineer in the field. Where pavement is to be removed to allow for the construction of utilities or other improvements, pavement shall be removed to the limits required for their construction.

3.02 Pavement Removal (Including Curb and Gutter Removal)

Pavement shall be removed to an existing joint or to a sawed joint. An existing crack is not suitable for the limit of removal. Sawed joints for pavement removal are to be either parallel or perpendicular to the longitudinal centerline. Sawed joints shall extend substantially through the full thickness of the pavement so that a "clean break" is made and that the adjacent pavement or structures that are to remain are not damaged. If adjacent pavement or structures that are to remain are damaged as a result of the Contractor's removal operations, they shall be replaced to the Owner's satisfaction at the Contractor's expense.

Curb and gutter removal shall be as directed by the Engineer. The Contractor shall sawcut existing curb and/or gutter perpendicular to and completely through the existing concrete.

Broken concrete, HMA, brick, and other debris resulting from pavement removal operations shall become the Contractor's property and disposed of properly.

Where pavements are encountered that are composed of more than one material or multiple courses of the same material, the pavement shall be removed in its entirety and all components shall be considered part of the same pavement area.

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

END OF SECTION

SECTION 024119 - SELECTIVE SITE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. The Work of this Section Includes:

1. Demolition and removal of selected site elements.
2. Potential removal and salvage of existing items for delivery to Owner and removal of existing items for reinstallation.

B. Related Requirements:

1. Section 015639 "Temporary Tree and Plant Protection" for temporary protection of existing trees and plants that are affected by selective demolition.
2. Section 311000 "Site Clearing" for site clearing and removal of above- and below-grade improvements not part of selective demolition.

1.2 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of off-site unless indicated to be removed and salvaged or removed and reinstalled.
- B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to Owner as indicated.
- C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage; prepare for reuse; and reinstall where indicated.
- D. Existing to Remain: Existing items of construction that are not to be removed.

1.3 MATERIALS OWNERSHIP

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

1.4 COORDINATION

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

1.5 PREINSTALLATION MEETINGS

- A. Predemolition Conference: Conduct conference at Project site.
 - 1. Inspect and discuss condition of construction to be selectively demolished.
 - 2. Review and finalize selective demolition schedule and verify availability of demolition personnel, equipment, and facilities needed to make progress and avoid delays.
 - 3. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
 - 4. Review areas where existing construction is to remain and requires protection.
 - 5. Review and finalize protection requirements.
 - 6. Review procedures for noise control and dust control.
 - 7. Review storage, protection, and accounting for items to be removed for salvage or reinstallation.
 - 8. Review demolition phasing regarding temporary use of existing building.

1.6 INFORMATIONAL SUBMITTALS

- A. Schedule of Selective Demolition Activities: Indicate the following:
 - 1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
 - 2. Temporary interruption of utility services. Indicate how long utility services will be interrupted.
 - 3. Coordination for shutoff, capping, and continuation of utility services.
 - 4. Use of elevator and stairs.
 - 5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.

1.7 FIELD CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials:
 - 1. It is not expected that hazardous materials will be encountered in the Work.

- a. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Contractor for a negotiated cost.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ANSI/ASSP A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.

3.2 PREPARATION

- A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.

3.3 UTILITY SERVICES AND BUILDING SYSTEMS

- A. Existing Services/Systems to Remain: Maintain utilities and systems and equipment to remain and protect against damage during selective demolition operations.
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utilities and building systems serving areas to be selectively demolished.
 1. Arrange to shut off utilities with utility companies.
 2. If disconnection of utilities and building systems will affect adjacent occupied parts of the building, provide temporary services/systems that bypass area of

selective demolition and that maintain continuity of services/systems to those parts of the building.

3.4 SALVAGE/REINSTALL

A. Removed and Salvaged Items:

1. Clean salvaged items.
2. Transport items to Owner's storage area.

B. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.
2. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

3.5 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

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

1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed trafficways if required by authorities having jurisdiction.
2. Use water mist and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations. Do not use water when it may damage adjacent construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.

3.6 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete:

1. Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4 inch at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.
2. Demolish in sections. Protect any concrete elements to remain.

3.7 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove demolition waste materials from Project site and recycle or dispose of them in accordance with Section 017419 "Construction Waste Management and Disposal."
 - 1. Do not allow demolished materials to accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 - 3. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."
- B. Burning: Do not burn demolished materials.

3.8 CLEANING

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

END OF SECTION 024119

SECTION 02 61 00
NON-HAZARDOUS CONTAMINATED MATERIAL DISPOSAL

PART 1 - GENERAL

1.01 Work Included

This work includes all labor, equipment, and materials necessary to handle, transport, and dispose of the non-hazardous contaminated material, including any and all laboratory testing required for the proper disposal of the material.

1.02 References

A. Hazardous Waste Management Act, Act 64, P.A. 1979

1.03 Related Work

A. Section 31 23 01 – Excavating, Filling, and Grading

1.04 Submittals

A. Disposal Facility

The Contractor shall provide the Engineer with the name and address of the Type II Sanitary Landfill which is proposed for disposal of contaminated non-hazardous material. The Contractor shall indicate if the proposed landfill is included in the county's solid waste disposal plan.

B. Composition Analysis

The Contractor shall provide the Engineer with the results of composition testing completed on any material potentially considered contaminated non-hazardous material.

PART 2 - PRODUCTS

Not Applicable

PART 3 - EXECUTION

3.01 Excavation of Non-Hazardous Contaminated Material

Non-hazardous contaminated material shall be excavated as shown on the plans or as directed by the Engineer.

3.02 Temporary Storage of Non-Hazardous Contaminated Material

Excavated non-hazardous contaminated material, which is to be temporarily stockpiled, shall be placed on plastic sheeting or tarps having a minimum thickness of 6 mils or in trucks, roll off boxes, or other containers, such that no liquid may escape from the containment. At the end of each work day, the non-hazardous contaminated material shall be covered securely with plastic sheeting of 6-mil thickness or greater.

Excavated non-hazardous material shall be disposed of as soon as approval is received from the disposal site. In no case shall this material be stockpiled for longer than 30 days prior to disposal.

3.03 Sampling and Analysis of Non-hazardous Contaminated Material

The Contractor shall be responsible for all sampling and analysis required for disposal of non-hazardous contaminated material, as required by the proposed disposal facility.

If the results of the analysis show the material to be hazardous, as defined by the Hazardous Waste Management Act, Act 64, P.A. 1979, the Engineer shall be notified immediately. The material shall then be disposed of as directed by the Engineer.

3.04 Disposal of Non-hazardous Contaminated Material

Disposal of non-hazardous contaminated material shall be at a licensed Type II Sanitary Landfill. The Contractor shall provide the Engineer the name of the Type II Sanitary Landfill to be used for disposal, the sampling analysis requirements of that landfill, and verification that the proposed landfill will meet the requirements of the county solid waste plan.

The Contractor shall provide a copy of the laboratory analysis to the Engineer. Following disposal and prior to approval for payment, the Contractor shall provide landfill receipts to the Engineer for all disposed non-hazardous contaminated material.

END OF SECTION

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Underslab vapor retarder.
- B. Moisture vapor reduction admixture (MVRA) for cast-in-place concrete floor slabs receiving moisture sensitive floor finishes.
- C. Concrete mix design requirements for concrete stain and polished finish systems.
- D. Reinforcing and jointing requirements for cast-in-place concrete floor slabs receiving hard tile floor finishes.
- E. Floor flatness and levelness tolerances; slabs on grade and suspended slabs.
- F. Concrete curing requirements for concrete stain and polished finish systems.
- G. Liquid densifier/hardener.

1.2 REFERENCE STANDARDS

- A. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete 1991 (Reapproved 2009).
- B. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete 2019.
- C. ASTM D4263 - Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method 1983 (Reapproved 2018).
- D. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs 2017.
- E. ASTM E1643 - Standard Practice for Selection, Design, Installation and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs 2018a.
- F. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes 2019a.
- G. ASTM E1155 - Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers 2020.
- H. ASTM E1155M - Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers (Metric) 2014.

I. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials 2021.

1.3 SUMMARY

- A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.
- B. Related Requirements:
 - 1. Section 312301 "Excavating, Filling, and Grading" for drainage fill under slabs-on-grade.
 - 2. Section 033543 "Concrete Floor Finishing" for flatness and levelness ratings for interior slabs and polished concrete finishing.

1.5 ACTION SUBMITTALS

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

1.6 INFORMATIONAL SUBMITTALS

- A. Material certificates.
- B. Material test reports.
- C. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.
- D. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer

1.9 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
 - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- B. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
- C. Concrete Curing:
 - 1. Prior to installing and curing concrete floor slabs to be stained and polished, verify with polished concrete materials manufacturer that curing products and methods are compatible with concrete staining and polishing.

1.11 PREINSTALLATION MEETING

- A. Preinstallation Conference: Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials.

Require representatives of each entity directly concerned with concrete materials, installation, and finishes, including polishing, to be present, including:

1. Contractor's Superintendent
 2. Independent testing agency responsible for concrete design mixtures.
 3. Ready-mix concrete manufacturer.
 4. Cast-in-Place concrete subcontractor.
 5. Polished concrete finishing subcontractor.
- B. Review mix design, cold-weather concreting procedures, curing procedures, construction joints, concrete repair procedures, concrete finishing, and protection of polished concrete.

1.12 PRECONSTRUCTION TESTING

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

1.13 FIELD CONDITIONS

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

1.14 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Slabs with Moisture Vapor Reduction Admixture (MVRA): Provide warranty to cover the cost of flooring failures due to moisture migration from slabs for ten years.
- C. Include cost of repair or removal of failed flooring, placement of topical moisture remediation system, and replacement of flooring with comparable flooring system.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

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

2.2 FORM-FACING MATERIALS

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

2.3 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.
- B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.
- C. Plain-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, plain, fabricated from as-drawn steel wire into flat sheets.
- D. Deformed-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, flat sheet.
- E. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice."

2.4 CONCRETE MATERIALS

- A. Cementitious Materials:
 - 1. Portland Cement: ASTM C 150/C 150M, Type I
 - 2. Fly Ash: ASTM C 618, Class F or C.
 - 3. Slag Cement: ASTM C 989/C 989M, Grade 100 or 120.
- B. Integral Color:
 - 1. Basis of Design: Solomon Colors, Inc, solomoncolors.com; ColorFlo SG Granular Color.
 - a. Color: 920 Onyx
 - b. Substitutions: See Section 01 2500 - Substitution Procedures.
- C. Normal-Weight Aggregates: ASTM C 33/C 33M, graded.
 - 1. Maximum Coarse-Aggregate
 - a. Size: 1 inches (38 mm) foundations; 3/4 inch (19 mm) nominal.
 - b. Color: 6A Natural; Provide Sample prior to installation.
 - 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. Water: ASTM C 94/C 94M.

2.5 UNDERSLAB VAPOR RETARDERS

- A. Underslab Vapor Retarder: Sheet material complying with ASTM E1745, Class A; stated by manufacturer as suitable for installation in contact with soil or granular fill under concrete slabs. The use of single ply polyethylene is prohibited.
- B. Installation: Comply with ASTM E1643.
- C. Accessory Products: Vapor retarder manufacturer's recommended tape, adhesive, mastic, prefabricated boots, etc., for sealing seams and penetrations.
- D. Minimum Thickness: 15 mil.
- E. Products:
 1. Fortifiber Building Systems Group: www.fortifiber.com.
 2. Intoplast Group; Barrier-Bac VB-350: www.barrierbac.com.
 3. ISI Building Products; Viper VaporCheck II 15-mil (Class A): www.isibp.com.
 4. Poly-America; Husky Yellow Guard 15-mil Vapor Barrier: www.yellowguard.com.
 5. Stego Industries, LLC; 15 mil: www.stegoindustries.com.
 6. W. R. Meadows, Inc; PERMINATOR Class A - 10 mils (0.25 mm): www.wrmeadows.com.
 7. Substitutions: See Section 01 2500 - Substitution Procedures.

2.6 WATERSTOPS

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

2.7 CURING MATERIALS

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

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

2.8 RELATED MATERIALS

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

2.9 CONCRETE MIXTURES, GENERAL

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

2.10 CONCRETE MIXTURES FOR BUILDING ELEMENTS

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

2.11 FABRICATING REINFORCEMENT

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

2.12 CONCRETE MIXING

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

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

2.13 CONCRETE FINISHING

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

PART 3 - EXECUTION

3.1 FORMWORK INSTALLATION

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

3.2 EMBEDDED ITEM INSTALLATION

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

3.3 VAPOR-RETARDER INSTALLATION

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

3.4 STEEL REINFORCEMENT INSTALLATION

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

3.5 JOINTS

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

3.6 WATERSTOP INSTALLATION

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

3.7 CONCRETE PLACEMENT

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

3.8 FINISHING FORMED SURFACES

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

3.9 FINISHING FLOORS AND SLABS

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

3.10 CONCRETE FINISHING APPLICATION

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

1. Apply cure-seal hardener to new concrete as soon as the concrete is firm enough to work on after troweling; with colored concrete, wait a minimum of 30 days before application.
 - a. Spray on at rate of 200 ft²/gal (5 m²/L).
 - b. Keep surface wet with cure-seal-hardener for a minimum soak-in period of 30 minutes without allowing it to dry or become slippery. If slipperiness occurs before the 30 minute time period has elapsed, apply additional cure-seal-hardener, as needed, to keep the entire surface in a non-slippery state for the first 15 minutes; for the remaining 15 minutes, mist the surface as needed with water to keep the material in a non-slippery state. In hot weather conditions, follow manufacturer's special application procedures.
 - c. When the treated surface becomes slippery after this period, lightly mist with water until slipperiness disappears.
 - d. Wait for surface to become slippery again, and then flush entire surface with water to remove all cure-seal-hardener residue.
 - e. Squeegee surface completely dry, flushing any remaining slippery areas until no residue remains.
 - f. Wet vacuum or scrubbing machines can be used in accordance with manufacturer's instructions to remove residue.
- B. New Concrete (Polished): Refer to Section 033543 "Concrete Floor Finishing" for requirements on finishing areas indicated to receive polished concrete finish.
- C. Protect installed floors for at least 3 months until chemical reaction process is complete.
 1. Do not allow traffic on floors for 3 hours after application.
 2. Do not allow parking of vehicles on concrete slab.
 3. If vehicles must be temporarily parked on slab, place drop cloths under vehicles during entire time parked.
 4. Do not allow pipe cutting using pipe cutting machinery on concrete slab.
 5. Do not allow temporary placement and storage of steel members on concrete slabs.
 6. Clean up spills immediately and spot-treat stains with degreaser or oil emulsifier.
 7. Clean floor regularly in accordance with manufacturer's recommendations.

3.11 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 305.1 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

3.12 CONCRETE SURFACE REPAIRS

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

3.13 FIELD QUALITY CONTROL

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

END OF SECTION 033000

SECTION 033543 - CONCRETE FLOOR FINISHING

PART 1 - GENERAL

1.1 SUMMARY

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

1.2 REFERENCE STANDARDS

- A. ASTM D4039 - Standard Test Method for Reflection Haze of High-Gloss Surfaces; 2015.
- B. ASTM D4263 - Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method; 2018.
- C. ASTM D5767 - Standard Test Method for Instrumental Measurement of Distinctness-of-Image (DOI) Gloss of Coated Surfaces; 2018.
- D. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
- B. 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 polished concrete to attend, including the following:
 - 1. Owner.
 - 2. Architect.
 - 3. Contractor's superintendent.
 - 4. Concrete producer.
 - 5. Cast-in-place concrete subcontractor.
 - 6. Polished concrete finishing Subcontractor.
- C. Review concrete mix, curing procedures, Projected 3, 14, and 28 day compressive strength test for finished floor, concrete protection prior to polishing and staining, construction joints, concrete finishing, and protection of polished concrete.
 - 1. Project phasing and scheduling for each step of grinding, honing and polishing operations including, but not limited to:
 - a. Quality of qualified personnel committed to project.
 - b. Quality and size of grinders committed to project.
 - c. Proper disposal of concrete slurry and/or dust.
 - 2. Details of each step of grinding, honing and polishing operations.
 - a. Application of color
 - b. Application of liquid applied products.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Submit polished concrete finishes manufacturer's specifications and test data.
 - 2. Submit polished concrete finishes describing product to be provided, giving manufacturer's name and product name for the specified material proposed to be provided under this section.
 - 3. Submit polished concrete finishes manufacturer's recommended installation procedures; which when approved by the Architect, will become the basis for accepting or rejecting actual installation procedures used on the work.
 - 4. Submit polished concrete finishes technical data sheet giving descriptive data, curing time, and application requirements.
- B. Polishing Schedule: Submit plan showing polished concrete surfaces and schedule of polishing operations for each area of polished concrete before start of polishing operations. Include location of all joints, including construction joints.
- C. Samples: For each type of product requiring color selection.
- D. Selection Samples: Where colors and finishes are not specified, submit 3 sets of color and finish selection charts or chips.
- E. Manufacturer's Qualification Statement.
- F. Installer's Qualification Statement.
- G. Maintenance Data: Provide data on maintenance and renewal of applied finishes.

1.5 QUALITY ASSURANCE

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

- e. Acids and acidic detergents will not come into contact with slab.
 - f. All trades informed that the slab must be protected at all times.
- E. Polished Concrete Finishes shall be defined according to the Concrete Polishing Council (CPC), a specialty council of the American Society of Concrete Contractors, as follows:
- 1. Aggregate Exposure: Denotes the surface exposure after grinding and polishing.
 - a. Class A: Cement Fines.
 - 1) Surface Exposure:
 - a) Cement Fines: 85 to 95 percent.
 - b) Fine Aggregates: 5 to 15 percent.
 - b. Class B: Fine Aggregate.
 - 1) Surface Exposure:
 - a) Fine Aggregates: 85 to 95 percent.
 - b) Blend of Cement Fines and Coarse Aggregates: 5 to 15 percent.
 - c. Class C: Coarse Aggregate.
 - 1) Surface Exposure:
 - a) Coarse Aggregates: 80 to 90 percent.
 - b) Blend of Cement Fines and Fine Aggregates: 10 to 20 percent.
- F. Polished Concrete Appearance:
- 1. Definitions:
 - a. DOI: Directness-of-Image Gloss; the sharpness of images of objects by reflection at a polished surface, sometimes called image clarity.
 - b. Image Clarity Value: DOI range from 0 to 100 percent where 100 represents a perfect DOI.
 - 1) Comply with ASTM D5767.
 - c. Haze Index:
 - 1) Haze is the cloudiness or milky appearance of images or objects produced by reflection in a polished surface.
 - 2) Haze index is obtained from testing per ASTM D4039; calculated from numeric difference between the value of specular gloss at 60 degrees and the value of specular gloss at 20 degrees.
 - 2. Level 1: Flat (Ground).
 - a. DOI: Images of objects being reflected have a flat appearance.
 - b. Image Clarity Value: 0 to 9
 - c. Haze Index: Less than 10.
 - 3. Level 2: Satin (Honed).
 - a. DOI: Images of objects being reflected have a matte appearance.
 - b. Image Clarity Value: 10 to 39
 - c. Haze Index: Less than 10.
 - 4. Level 3: Polished.
 - a. DOI: Images of objects being reflected do not have a sharp or crisp appearance but can be easily identified.
 - b. Image Clarity Value: 40 to 69
 - c. Haze Index: Less than 10.
 - 5. Level 4: Highly Polished.
 - a. DOI: Images of objects being reflected have a sharp and crisp appearance as would be seen in a near-mirror like reflection.
 - b. Image Clarity Value: 70 to 100.
 - c. Haze Index: Less than 10.

1.6 MOCK-UP

- A. Before casting concrete, build mockups to verify selections made under Sample submittals and to demonstrate typical joints, edge conditions, surface finish, tolerances, and standard of workmanship. Build mockups to comply with the following requirements, using materials indicated for the completed Work:
1. Build mockups in the location and of the size indicated or, if not indicated, as directed by Architect.
 2. At location on Project selected by Architect, place and finish a 100 square foot area of dye stained ground and polished concrete
 3. Demonstrate curing, finishing, and protecting of polished concrete.
 4. Mockup shall be produced by the individual workers who will perform the work for the Project.
 5. Mock-up shall be representative of work to be expected.
 6. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
 7. Include example of transition or border between one stain color to another.

1.7 PROJECT CONDITIONS

- A. Environmental limitations:
1. Comply with manufacturers written instructions for substrate temperature and moisture content, ambient temperature and humidity, ventilation, and other conditions affecting topping performance.
 - a. Concrete Floor Flatness rating: 40 minimum.
 - b. Concrete Floor Levelness rating: 30 minimum.
 - c. Concrete must be cured a minimum of 45 days or as directed by the manufacturer before application of Retro Plate can begin.
- B. Close areas to traffic during floor application and after application, for time period recommended in writing by manufacturer.
- C. Maintain light level equivalent to a minimum 200 W light source at 8 feet above the floor surface over each 20 foot square area of floor being finished.
- D. Maintain ambient temperature of 50 degrees F minimum.
- E. Damage and Stain Prevention: It is the responsibility of all in the project to prevent damage and staining of concrete surfaces to be polished.
1. Prohibit the use of markers, spray paint and soapstone.
 2. Prohibit improper application of liquid membrane film forming curing compounds.
 3. Prohibit vehicle or lift parking over concrete surfaces.
 4. Prohibit pipe-cutting operations over concrete surfaces.
 5. Prohibit storage of any items over concrete surfaces for not less than 28 days after concrete placement.
 6. Prohibit ferrous metals storage over concrete surfaces.
 7. Protect from petroleum, oil, hydraulic, or other liquid dripping from equipment working over concrete surfaces.
 8. Protect from acids and acidic detergents contacting concrete surfaces.
 9. Protect from paint activities over concrete surfaces.

PART 2 - PRODUCTS

2.1 LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatments for Polished Concrete Finish: Clear, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens, and is suitable for polished concrete surfaces.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide the following:
 - a. Retro-Plate 99, manufactured by Advanced Floor Products, Inc., P.O. Box 50533, Provo, Utah 84605, 801-812-3420.
 - 1) Performance Criteria:
 - a) Abrasion Resistance: ASTM C779 - Up to 400% increase in abrasion resistance.
 - b) Impact Strength: ASTM C805 - Up to 21% increase impact strength.
 - c) Ultra-Violet Light and Water Spray: ASTM G23-81 - No adverse effect to ultra-violet and water spray.
 - d) Reflectivity: Up to 30% increase in reflectivity.
 - b. Substitutions: See Section 012500 for Substitutions

2.2 RELATED MATERIALS

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

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS:

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

3.2 APPLICATION

- A. Start any of the floor finish applications in the presence of manufacturer's technical representative.
- B. Sealing, Hardening and Polishing of Concrete Surface
 - 1. Concrete must be in place a minimum of 45 days or as directed by the manufacturer before application can begin.
 - 2. Application is to take place at least 10 days prior to racking and other in-store accessory installation, thus providing a complete, uninhibited concrete slab for application

3. Only a certified applicator shall apply Liquid Floor Treatments. Applicable procedures must be followed as recommended by the product manufacturer and as required to match the approved test sample.
4. Achieve waterproofing, hardening, dustproofing, and abrasion resistance of the surface without changing the natural appearance of the concrete, except for the sheen.
5. Apply joint filler per manufactures written instructions. Overfill joint to ensure complete fill and shave off excess material flush with concrete floor surface to achieve a smooth, uniform surface free of voids and gaps.

3.3 POLISHING

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

END OF SECTION

SECTION 04 2000 - UNIT MASONRY

PART 1 GENERAL

1.1 SECTION INCLUDES

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

1.2 REFERENCE STANDARDS

- A. ACI 315 - Guide to Presenting Reinforcing Steel Design Details; 2018.
- B. ASTM D1056 - Standard Specification for Flexible Cellular Materials—Sponge or Expanded Rubber 2020.
- C. ASTM D2000 - Standard Classification System for Rubber Products in Automotive Applications 2018.
- D. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components 2019.
- E. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications 2020a.
- F. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement 2020.
- G. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units 2021.
- H. ASTM C91/C91M - Standard Specification for Masonry Cement 2018.
- I. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar 2018.
- J. ASTM C150/C150M - Standard Specification for Portland Cement 2021.
- K. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes 2018.
- L. ASTM C216 - Standard Specification for Facing Brick (Solid Masonry Units Made From Clay or Shale) 2021.
- M. ASTM C270 - Standard Specification for Mortar for Unit Masonry 2019a, with Editorial Revision.
- N. ASTM C404 - Standard Specification for Aggregates for Masonry Grout 2018.
- O. ASTM C476 - Standard Specification for Grout for Masonry 2020.

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

1.3 ADMINISTRATIVE REQUIREMENTS

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

1.4 SUBMITTALS

- A. See Section 01 4000 - Quality Requirements, for submittal procedures.
- B. Product Data: Provide data for the following:
 - 1. Masonry Units:
 - a. Include data on material properties.
 - b. Masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.
 - 2. Cementitious materials. Include name of manufacturer, brand name and type.
 - 3. Mortar admixtures.
 - 4. Preblended, dry mortar mixes. Include description of type and proportion of ingredients.
 - 5. Grout mixes. Include description of type and proportion of ingredients.
 - 6. Sound Isolating anchors.
 - 7. Anchors, ties, weep/cavity vent, preformed control-joint gaskets, cavity drainage material, and metal accessories.
- C. Shop Drawings: Indicate pertinent dimensions, materials, anchorage, size and type of fasteners, and accessories for masonry.
 - 1. Masonry Units: Indicate sizes, profiles, coursing, and locations of special units.
 - 2. Reinforcing: Indicate bending, lap lengths, and placement of unit masonry reinforcing bars.
 - a. Comply with ACI 315.
 - 3. Flashings: Provide details of embedded flashings including end dams, corners, drips, weeps.

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

1.5 QUALITY ASSURANCE

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

1.6 MOCK-UP

- A. Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for material and execution.
- B. Construct a masonry wall as a mock-up panel sized 8 feet long by 6 feet high; include mortar, accessories, structural backup, wall openings, flashings (with lap joint, corner, and end dam), through-wall flashing (omit masonry above half of flashings, wall insulation, and sealant-filled joint at least 16 inches long in exterior wall in mock-up).
- C. Include lower corner of window opening at upper corner of exterior wall mockup. Make opening approximately 12 inches wide by 16 inches high.
- D. Locate where directed.
- E. Where masonry is to match existing, erect mockups adjacent and parallel to existing surface.

- F. Clean one-half of exposed faces of mockups with masonry cleaner as indicated.
- G. Approval of mockups is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.
 - 1. Approval of mockups is also for other materials and construction qualities specifically approved by Architect in writing.
 - 2. Approval of mockups does not constitute approval of deviations from Contract Documents contained in the mock-ups unless Architect specifically approves such deviations in writing.

1.7 DELIVERY, STORAGE, AND HANDLING

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

1.8 FIELD CONDITIONS

- A. Protection of Masonry: During construction, cover tops of walls, protections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
 - 1. Extend cover a minimum of 24 inches (600 mm) down both sides of walls, and hold cover securely in place.
 - 2. Where one wythe of multi-wythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches (600 mm) down face next to unconstructed wythe, and hold cover in place.
- B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.
- C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
 - 1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
 - 2. Protect sills, ledges, and projections from mortar droppings.
 - 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
 - 4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit ma

sonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.
2. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

PART 2 PRODUCTS

2.1 UNIT MASONRY, GENERAL

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

2.2 CONCRETE MASONRY UNITS (CMU-1)

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

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

2.3 MORTAR AND GROUT MATERIALS

- A. Masonry Cement: ASTM C91/C91M.
- B. Mortar Cement: ASTM C1329.
- C. Portland Cement: ASTM C150/C150M, Type I.
- D. Hydrated Lime: ASTM C207, Type S.
- E. Mortar Aggregate: ASTM C144.
- F. Grout Aggregate: ASTM C404.
- G. Pigments for Colored Mortar: Pure, concentrated mineral pigments specifically intended for mixing into mortar and complying with ASTM C979/C979M.
 1. Color(s): 94X.
 2. Manufacturers:
 - a. Davis Colors: www.daviscolors.com.
 - b. Lambert Corporation: www.lambertusa.com.
 - c. Solomon Colors: www.solomoncolors.com/sle.
 - d. Substitutions: See Section 012500 - Product Requirements.
- H. Water: Clean and potable.
- I. Integral Water Repellent Admixture for Mortar: Polymeric liquid admixture added to mortar at the time of manufacture.
 1. Locations: Provide at exposed exterior concrete block and elsewhere as indicated.
 2. Limitations:
 - a. Use only in combination with masonry units manufactured with integral water repellent admixture.

- b. Source Limitations: Use water repellent admixtures for masonry units and mortar from a single manufacturer.
 3. Meet or exceed performance specified for water repellent admixture used in masonry units.
 4. Products:
 - a. BASF Corp.; MasterPel 210MA: www.master-builders-solutions.basf.us.
 - b. Euclid Chemical Company (The); an RPM company; Blocktite Mortar Admixture: www.euclidchemical.com.
 - c. GCP Applied Technologies Inc.; Dry-Block Mortar Admixture: www.gcpat.com.
 - d. Substitutions: See Section 012500 - Product Requirements.
- J. Packaged Dry Material for Mortar for Unit Masonry:
 1. Contractor's option, prepackaged dry material for mortar may be used subject to compliance with mortar requirements of this section including, but not limited to, the following:
 - a. Mortar Types: As indicated.
 - b. Color(s): As selected by Architect from manufacturer's full range.
 - c. Use only water repellent admixture for mortar from the same manufacturer as water repellent admixture in masonry units.
 2. Portland Cement Based: Premixed Portland cement, hydrated lime, and sand; complying with ASTM C1714/C1714M and capable of producing mortar of the specified strength in accordance with ASTM C270 with the addition of water only.
 - a. Manufacturers:
 - 1) Amerimix, an Oldcastle brand; www.amerimix.com.
 - 2) The QUIKRETE Companies; www.quikcrete.com.
 - 3) SPEC MIX, Inc.: www.specmix.com.
 - 4) Substitutions: See Section 012500 - Substitution Procedures.
 3. Masonry Cement Based: Premixed masonry cement and mason's sand; complying with ASTM C1714/C1714M and capable of producing mortar of the specified strength in accordance with ASTM C270 with the addition of water only.
 - a. Manufacturers:
 - 1) Amerimix, an Oldcastle brand; www.amerimix.com.
 - 2) The QUIKRETE Companies; www.quikcrete.com.
 - 3) SPEC MIX, Inc.: www.specmix.com.
 - 4) Substitutions: See Section 012500 - Substitution Procedures.
- K. Packaged Dry Material for Grout for Masonry: Premixed cementitious materials and dried aggregates; capable of producing grout of the specified strength in accordance with ASTM C476 with the addition of water only.
 1. At Contractor's option, prepackaged dry material for grout may be used subject to compliance with grout requirements of this section.
 2. Manufacturers:
 - a. Amerimix, an Oldcastle brand; www.amerimix.com.
 - b. The QUIKRETE Companies; www.quikcrete.com.
 - c. SPEC MIX, Inc.: www.specmix.com.
 - d. Substitutions: See Section 012500 - Substitution Procedures.

2.5 REINFORCEMENT AND ANCHORAGE

- A. Manufacturers:
1. Basis-of-Design Product: The design for each item specified is based on the product named. Provide either the named product or a comparable product by one of the following:
 - a. Fero Corp.; www.ferocorp.com.
 - b. Heckmann Building Products; www.heckmannbuildingprods.com.
 - c. Hohmann & Barnard, Inc.; www.h-b.com.
 - d. Wire-Bond; www.wirebond.com.
 - e. Substitutions: See Section 012500 - Substitution Procedures.
- B. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi), deformed billet bars; Uncoated.
- C. Reinforcing Bar Positioners: 0.156 inch, ASTM A1064/A1064M steel wire, hot dip galvanized after fabrication to 16 CFR 1201 Class B.
1. Basis-of-Design Product: Hohmann & Barnard, Inc.; www.h-b.com: RB and RB-Twin Rebar Positioners.
- D. Reinforcing Bar Lap Joint Ties: ASTM A1064/A1064M steel wire, mill galvanized to 16 CFR 1201 Class 3.
1. Basis-of-Design Product: Hohmann & Barnard, Inc.; www.h-b.com: Spyra-Lox Rebar Lap- Joint Tie.
- E. Single Wythe Joint Reinforcement: Truss or ladder type; ASTM A1064/A1064M steel wire, hot dip galvanized after fabrication to 16 CFR 1201 Class B; 0.1483 inch side rods with 0.1483 inch cross rods; width as required to provide not more than 1 inch and not less than 1/2 inch of mortar coverage on each exposure.
1. Basis-of-Design Product: Hohmann & Barnard, Inc.; www.h-b.com: 120 Truss-Mesh or 220 Ladder-Mesh.
- F. Adjustable Multiple Wythe Joint Reinforcement: Truss or ladder type with adjustable ties or tabs spaced at 16 in on center ASTM A1064/A1064M steel wire, hot dip galvanized after fabrication to ASTM A153/153M, Class B; 0.1483 inch side rods with 0.1483 inch cross rods and adjustable components of 0.1875 inch wire; width of components as required to provide not more than 1 inch and not less than 1/2 inch of mortar coverage from each masonry face.
1. Basis-of-Design Product: Hohmann & Barnard, Inc.; www.h-b.com: 170 Truss LOX-ALL Adjustable Eye Wire or 270 Ladder LOX-ALL Adjustable Eye Wire with 2X-HOOK.
- G. Rigid Anchors: Fabricate from steel bars 1-1/2 inches wide by 1/4 inch thick by 24 inches long, with ends turned up 2 inches; hot dip galvanized to ASTM A153/A153M Class B.
1. Basis-of-Design Product: Hohmann & Barnard, Inc.; www.h-b.com: 344 Rigid Partition Anchor.
- H. Partition Top Anchors: 0.1875 inch thick metal plate with a 3/8 inch diameter metal rod 6 inches long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube; hot dip galvanized to ASTM A153/A153M Class B.
1. Basis-of-Design Product: Hohmann & Barnard, Inc.; www.h-b.com: PTA-420-HS and PTA Tubes.
- I. Dovetail Anchor Slots for Connecting to Concrete: 2-piece anchors that permit differential movement between masonry and concrete frame, sized to provide not more than 1 inch and not less than 1/2 inch of mortar coverage from masonry face.

1. Concrete frame: Dovetail anchors of bent steel, nominal 1 inch width by 1 inch deep by 0.03 in thick, with trapezoidal wire ties 0.1875 inch thick, hot dip galvanized to ASTM A 153/A 153M, Class B.
 - a. Basis-of-Design Product: Hohmann & Barnard, Inc.; www.h-b.com: 305 Dovetail Slot with 315 Flexible Dovetail Brick Ties.
- J. Adjustable Anchors for Connecting to Structural Steel Framing: 2-piece anchors that permit differential movement between masonry and steel frame, sized to provide not more than 1 inch and not less than 1/2 inch of mortar coverage from masonry face.
 1. Crimped wire anchors for welding to frame, 0.25 inch thick, with trapezoidal wire ties 0.1875 inch thick, hot dip galvanized to ASTM A 153/A 153M, Class B.
 2. Basis-of-Design Product: Hohmann & Barnard, Inc.; www.h-b.com: 359/359FP anchors with 301W or VBT ties.
- K. Adjustable Masonry Veneer Anchors: 2-piece anchors that permit differential movement between masonry veneer and structural backup, hot dip galvanized to ASTM A 153/A 153M, Class B.
 1. For cold-formed metal framing and sheathing back-up.
 2. Anchor plates: Not less than 0.075 inch thick, designed for fastening to structural backup through sheathing by two fasteners.
 3. Wire ties: Rectangular shape, 0.1875 inch thick.
 4. Vertical adjustment: Not less than 2 inches.
 5. Basis-of-Design Product: Hohmann & Barnard, Inc.; www.h-b.com: HB-213 anchors with 2X-HOOK.
- L. Sound Isolating Anchors.
 1. Provide as indicated on the Drawings.
 - a. Basis of Design Product: Provide PSB-M isolators as manufactured by Kinetics. Texture Wire cut or as follows:
 - 1) Mason Industries AB-716.

2.6 FLASHINGS

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

- a. Manufacturer shall be the same as flexible fabric flashing manufacturer.

2.7 CAVITY WALL INSULATION

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

2.8 ACCESSORIES

- A. Preformed Control Joints: Rubber material. Provide with corner and tee accessories, fused joints. ASTM D2000, 2AA-805.
 1. Manufacturers:
 - a. Hohmann & Barnard, Inc: www.h-b.com/sle.
 - b. WIRE-BOND: www.wirebond.com/#sle.
 - c. Substitutions: See Section 012500 - Substitution Procedures.
- B. Compressible Joint Filler: Closed cell neoprene; oversized 50 percent to joint width; self expanding; in maximum lengths available. ASTM D1056, Grade 2A1.
 1. Manufacturers:
 - a. Hohmann & Barnard, Inc: www.h-b.com/sle.
 - b. WIRE-BOND: www.wirebond.com/#sle.
 - c. Substitutions: See Section 012500 - Substitution Procedures.
- C. Cavity Mortar Control/Drainage Material: Semi-rigid polyethylene or polyester mesh panels, sized to thickness of wall cavity, and designed to prevent mortar droppings from clogging weeps and cavity vents and allow proper cavity drainage.
 1. Mortar Diverter: Semi-rigid mesh designed for installation at flashing locations.
 - a. Full depth of cavity and 10 inches high, with dovetail-shaped notches 7 inches deep that prevent clogging with mortar droppings.
 - b. Basis-of-Design Product: Provide Hohmann & Barnard, Inc.; www.h-b.com; Mortar Trap or a comparable product by one of the following:
 - 1) Advanced Building Products Inc.; www.advancedbuildingproducts.com.
 - 2) Heckmann Building Products; www.heckmannbuildingprods.com.
 - 3) Mortar Net Solutions; www.mortarnet.com.
 - 4) Wire-Bond; www.wirebond.com.
 - 5) Substitutions: See Section 012500 - Substitution Procedures.
- D. Building Paper: ASTM D226/D226M, Type I ("No.15") asphalt felt.
- E. Termination Bars: Stainless steel, 1/8 inch thick by 1-1/2 inch high with 3/8 inch sealant flange at top; compatible with flashing membrane and adhesives.
 1. Manufacturers:
 - a. Advanced Building Products Inc.; www.advancedbuildingproducts.com
 - b. Heckmann Building Products; www.heckmannbuildingprods.com.
 - c. Hohmann & Barnard, Inc.; www.h-b.com.
 - d. Wire-Bond; www.wirebond.com.
 - e. York Manufacturing, Inc.; www.yorkmfg.com

- f. Substitutions: See Section 012500 - Substitution Procedures.
- F. Weep Inserts and Cavity Vents:
 - 1. Type: Plastic cellular/honeycomb design.
 - 2. Color(s): As selected by Architect from manufacturer's full range.
 - 3. Basis-of-Design Product: Provide Hohmann & Barnard, Inc.; www.h-b.com; QV Quadro- Vent or a comparable product by one of the following:
 - a. Advanced Building Products Inc.; www.advancedbuildingproducts.com.
 - b. Heckmann Building Products; www.heckmannbuildingprods.com.
 - c. Mortar Net Solutions; www.mortarnet.com.
 - d. Wire-Bond; www.wirebond.com.
 - e. Substitutions: See Section 012500 - Substitution Procedures.
- G. Mortar and Grout Screen: 1/4 inch square, polypropylene monofilament screening for preventing grout flow; width sized to match masonry widths.
 - 1. Basis-of-Design Product: Provide Hohmann & Barnard, Inc.; www.h-b.com; MGS or a comparable product by one of the following:
 - a. Heckmann Building Products; www.heckmannbuildingprods.com.
 - b. Wire-Bond; www.wirebond.com.
 - c. Substitutions: See Section 012500 - Substitution Procedures.
- H. Masonry Cleaners:
 - 1. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.
 - a. Basis-of-Design Products: Provide PROSOCO, Inc.; www.prosoco.com: Sure Klean 600 or Sure Klean Vana Trol or a comparable product by one of the following:
 - 1) Diedrich Technologies, Inc.; www.diedrichtechnologies.com.
 - 2) Substitutions: See Section 012500 - Substitution Procedures.

2.9 LINTELS

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

2.10 MORTAR AND GROUT MIXING

- A. Mortar for Unit Masonry: ASTM C270, using the Proportion Specification.
 - 1. Masonry below grade and in contact with earth: Type M.
 - 2. Exterior, loadbearing masonry: Type S.
 - 3. Exterior, non-loadbearing masonry: Type N.
 - 4. Interior, loadbearing masonry: Type N.
 - 5. Interior, non-loadbearing masonry: Type N.
 - 6. Precast concrete units: Same Type as wall masonry in which unit is set.
 - 7. Limestone units: Same Type as wall masonry in which unit is set.
 - 8. Pointing Mortar: Type N.
- B. Colored Mortar: Proportion selected pigments and other ingredients to match Architect's sample, without exceeding manufacturer's recommended pigment-to-cement ratio.

- C. Grout: ASTM C476; consistency required to fill completely volumes indicated for grouting; fine grout for spaces with smallest horizontal dimension of 2 inches or less; coarse grout for spaces with smallest horizontal dimension greater than 2 inches.
 - 1. Grout Strength: 3000 psi at 28 days, unless otherwise indicated.
- D. Admixtures: Add to mixture at manufacturer's recommended rate and in accordance with manufacturer's instructions; mix uniformly.
- E. Mixing: Use mechanical batch mixer and comply with referenced standards.

PART 3 EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

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

3 INSTALLATION, GENERAL

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

3.2 COURSING

- A. Establish lines, levels, and coursing indicated. Protect from displacement.
- B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
- C. Existing Masonry: Match coursing and bonding of existing masonry unless otherwise indicated.
- D. Concrete Masonry Units: Unless otherwise indicated:
 - 1. Bond: Running.
 - 2. Coursing: One unit and one mortar joint to equal 8 inches.

3. Mortar Joints: Concave.
4. Mortar Joint Thickness: 3/8 inch.

3.3 PLACING AND BONDING

- A. Lay hollow masonry units with face shell bedding on head and bed joints.
- B. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.
- C. Remove excess mortar and mortar smears as work progresses.
- D. Remove excess mortar with water repellent admixture promptly. Do not use acids, sandblasting or high-pressure cleaning methods.
- E. Interlock intersections and external corners.
- F. Tooth-in new masonry work with existing, unless otherwise indicated on Drawings.
- G. Tooth-in cutting and patching masonry work unless otherwise indicated on Drawings.
- H. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar, and replace.
- I. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
- J. Cut mortar joints flush where wall tile is scheduled, or resilient base is scheduled.
- K. Isolate the top joint of masonry partitions from horizontal structural framing members and slabs or decks with compressible joint filler.
- L. Isolate cast stone units and precast architectural concrete units from clay masonry with building paper or similar method of providing a continuous bond break/slip plane.
- M. Set cast-stone trim units in full bed of mortar with full vertical joints. Fill dowel, anchor, and similar holes.
 1. Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with clear water.
 2. Allow cleaned surfaces to dry before setting.
 3. Wet joint surfaces thoroughly before applying mortar.
 4. Rake out mortar joints for pointing with sealant.

3.4 WEEPS INSERTS/CAVITY VENTS

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

3.5 CAVITY MORTAR CONTROL

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

- D. Install cavity mortar diverter at base of cavity and at other flashing locations as recommended by manufacturer to prevent mortar droppings from blocking weep/cavity vents.

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

- A. Unless otherwise indicated on drawings or specified under specific wall type, install horizontal joint reinforcement 16 inches on center.
- B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.
- C. Place continuous joint reinforcement in the first and second joint below top of walls.
- D. Lap joint reinforcement ends minimum 6 inches.
- E. Masonry to Structural Steel and Concrete:
 - 1. Provide an open space not less than 1/2 inch wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
 - 2. Fasten anchors to structural framing and embed in masonry joints as masonry is laid. Unless otherwise indicated on drawings or closer spacing is indicated under specific wall type, space anchors at maximum of 24 inches horizontally and 24 inches vertically.
- F. Embed ties and anchors in mortar joint and extend into masonry unit a minimum of 1-1/2 inches with at least 5/8-inch mortar cover to the outside face of the anchor.

3.7 MASONRY VENEER REINFORCEMENT AND ANCHORAGE

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

3.8 MASONRY FLASHINGS

- A. General:
 - 1. Install masonry flashings according to manufacturer's instructions and as indicated on the Drawings.
 - 2. Remove or cover protrusions or sharp edges that could puncture flashings.
 - 3. Lap end joints of flashings at least 6 inches, minimum, and seal watertight with flashing sealant/adhesive.
 - 4. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.
 - a. Extend flashings full width at such interruptions and at least 6 inches, minimum, into adjacent masonry or turn up at least 8 inches, minimum, to form watertight pan at non-masonry construction.
 - 5. Terminate flashing up 8 inches minimum on vertical surface of backing:

- a. Install vertical leg of flashing over fluid-applied or self-adhered air/vapor barriers over backing or per manufacturer's direction, unless otherwise indicated.
- b. Anchor vertical leg of flashing into backing with a termination bar and sealant.
6. Install flashing in accordance with manufacturer's instructions and BIA Technical Notes No. 7, unless more stringent requirements are specified in this section.
- B. Flexible Fabric Flashing:
 1. Use factory-fabricated drip plates, corners and end dams.
 2. Extend flexible fabric flashing to within 1/4 inch of exterior face of masonry overlapping metal drip plate.
 3. Extend flexible fabric flashing full width of cavity space and turn up inner masonry wythe or sheathing at least 14 inches.
 4. Secure flexible fabric flashing to wall with continuous termination bar and apply sealant across top of termination bar.

3.9 LINTELS

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

3.10 BOND BEAMS

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

3.11 VERTICAL MASONRY REINFORCEMENT

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

3.12 GROUTING

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

3.13 GROUTED COMPONENTS

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

3.14 CONTROL AND EXPANSION JOINTS

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

3.15 BUILT-IN WORK

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

1. Fill adjacent masonry cores with grout minimum 12 inches from framed openings.

3.16 TOLERANCES

A. Dimensions and Locations of Elements:

1. Location of elements in plan; do not vary from that indicated on Drawings by more than:
 - a. Plus or minus 1/2 inch.
2. Dimensions in cross section; do not vary from that indicated on Drawings by more than:
 - a. Minus 1/4 inch.
 - b. Plus 1/2 inch.
3. Maximum Variation from Alignment of Columns and Pilasters: 1/4 inch.
4. Maximum Variation From Unit to Adjacent Unit: 1/16 inch.
5. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft and 1/2 inch in 20 ft or more.
6. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.
7. Maximum Variation from Level Coursing: 1/8 inch in 3 ft and 1/4 inch in 10 ft; 1/2 inch in 30 ft.
8. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch.
9. Lines and Levels:
 - a. Maximum variation from level:
 - 1) Includes, but is not limited to, the following:
 - (a) Lintels.
 - (b) Sills.
 - (c) Parapets.
 - (d) Reveals.
 - (e) Other conspicuous lines.
 - 2) Do not vary from level by more than:
 - (a) 1/4 inch in 20 feet.
 - (b) 1/2 in in 40 feet or more.
 - b. Maximum variation from plumb:
 - 1) Includes, but is not limited to, the following:
 - (a) External corners.
 - (b) Control and expansion joints.
 - (c) Reveals.
 - (d) Other conspicuous lines.
 - 2) Do not vary from plumb by more than:
 - (a) 1/4 inch in 20 feet.
 - (b) 1/2 in in 40 feet or more.
10. Mortar Joint Thickness: Do not vary thickness indicated by more than plus or minus 1/8 inch.

3.17 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Section 01 4000 - Quality Requirements.

3.18 CLEANING

- A. Protect surrounding elements and finishes from damage due to cleaning procedures.

- B. Appearance Standard: Cleaned surfaces are to have a uniform appearance as viewed from 10 feet away, subject to Architect's approval.
- C. Remove excess mortar and mortar droppings.
- D. Clean soiled surfaces with cleaning solution.
- E. Apply masonry cleaners to masonry surfaces according to manufacturer's written instructions; use brush or spray application.
 - 1. Periodically during rinsing, test pH of rinse water running off of cleaned area to determine that chemical cleaner is completely removed.
 - a. Repeat rinsing until tested pH of water runoff is between 6.7 and 7.5.

END OF SECTION - 042000

SECTION 044200 - LIMESTONE MASONRY

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Dolomite limestone.
 - 2. Thin Adhered Limestone.
- B. Related Requirements
 - 1. Section 042000 - Unit Masonry.

1.2 ACTION SUBMITTALS

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

1.3 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturer having sufficient plant facilities to produce the shapes, quantities and size of Products required in accordance with the project schedule.
- B. Obtain stone from a single quarry source with resources to provide materials of specified consistent quality.
- C. Installer: Company or person specializing in commercial masonry work with 10 years documented experience.
- D. Sample Panels: Build sample panels to verify selections made under Sample submittals and to demonstrate aesthetic effects.
- E. Samples to be 4'-0 x 4'-0 for typical exterior wall.

1.4 MOCKUPS

- A. Construct typical mockup panel 48" x 48" to illustrate stone, coursing or bond pattern, joints between units, and movement control joints.
- B. Construct mockups to illustrate backup wall, exterior sheathing, air barrier, cavity wall insulation, connectors, weep holes, cavity vents, and through wall flashing.
- C. Mockup may remain part of the finished Work.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver Limestone units in protective film. Prevent damage to units.
- B. Lift skids with proper and sufficiently long slings or forks with protection to prevent damage to units. Protect edges and corners.
- C. Store units in a manner designed to prevent damage and staining of units.
- D. Stack units on timbers or platforms at least 3 inches above grade.
- E. Place polyethylene or other plastic film between wood and other finished surfaces of units when stored for extended periods of time.

- F. Cover stored units with protective enclosure if exposed to weather.
- G. Do not use salt or calcium-chloride to remove ice from masonry surfaces.
- H. Store adhered masonry veneer and installation system materials in a dry location; handle in a manner to prevent chipping, breakage, and contamination.
- I. Protect latex additives, liquid air barriers, waterproofing membranes, epoxy adhesives and sealants from freezing or overheating in accordance with manufacturer's instructions; store at room temperature when possible.
- J. Store portland cement mortars and pointing mortars in a dry location.

1.6 PROJECT/SITE CONDITIONS

- A. Provide ventilation and protection of environment as recommended by manufacturer.
- B. Prevent carbon dioxide damage to adhered masonry veneer, trim, as well as adhesives, liquid air and water barrier ,mortars, pointing mortars and other installation materials, by venting temporary heaters to the exterior.
- C. Maintain ambient temperatures not less than 37°F (3°C) or more than 100°F (38°C) during installation and for a minimum of seven (7) days after completion. Setting of portland cement is retarded by low temperatures.
 - 1. Protect work for extended period of time and from damage by other trades.
 - 2. Epoxy mortars and epoxy pointing mortars require surface temperatures between 60°F (16°C) and 90°F (32°C) at time of installation.
 - 3. Liquid air barrier and waterproofing Membranes require surface temperatures between 50°F (10°C) and 90°F (32°C). It is the General Contractor's responsibility to maintain temperature control.

1.7 ATTIC STOCK

- A. Extra stock is to be from same production run or batch as original adhered masonry veneer and installation materials.
- B. Upon completion of the work of this Section, deliver to the Owner 2% minimum additional adhered masonry veneer and trim shapes or a minimum of 2 additional pieces of each type, color, pattern and size used in the Work, as well as extra stock of adhesives, mortars, pointing mortars and other installation materials for the Owner's use in replacement and maintenance.

1.8 WARRANTY

- A. Limestone Masonry installed over concrete masonry unit substrate:
 - 1. The Contractor warrants the work of this Section to be in accordance with the Contract Documents and free from faults and defects in materials and workmanship for a period of 25 years. The manufacturer of adhesives, liquid air and water barrier, mortars, pointing mortars and other installation materials shall provide a written twenty five (25) year warranty, which covers materials and labor - reference LATICRETE Warranty Data Sheet 025.OSPD for complete details and requirements.
- B. Limestone Masonry installed over steel framing.
 - 1. The Contractor warrants the work of this Section to be in accordance with the Contract Documents and free from faults and defects in materials and workmanship for a period of 15 years. The manufacturer of adhesives, liquid air and water barrier, mortars, pointing mortars and other installation materials shall provide a written twenty five (15) year warranty, which covers materials and labor - reference LATICRETE Warranty Data Sheet 230.15SPD for complete details and requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

2.2 MATERIALS

- A. Dolomitic Limestone: ASTM C568, Category III - High-Density; special shapes as indicated;
1. ST-1; Exterior Limestone; ADAIR PARLIMENT
 - a. Physical Properties: having the following typical average properties when tested to the identified standard:
 - 1) Compressive Strength: 22,900 psi, to ASTM C170.
 - 2) Absorption: 0.75 percent, to ASTM C97.
 - 3) Density: 167 lb/ft³, to ASTM C97.
 - 4) Modulus of Rupture: 2,250 psi, to ASTM C99.
 - 5) Flexural Strength: 1,600 psi, to ASTM C880.
 - 6) Abrasion Resistance: 18.0, to ASTM C241.
 - b. Product and Manufacturer's Name: Adair Parliment Masonry Units by Arriscraft
 - c. Finish: Split Face finish on exposed faces and ends.
 - d. Dimensions:
 - 1) Bed Thickness: 3-5/8" thick.
 - 2) Unit Length: various lengths up to 35-5/8" long.
 - 3) Unit Height: As Indicated on drawings
 - e. Color and Pattern: Sepia color, Veined pattern, to match approved sample range.
 2. ST-2; Interior/Exterior Fully Adhered Wall Tile; ADAIR LIMESTONE TILE
 - a. Physical Properties: having the following typical average properties when tested to the identified standard:
 - 1) Compressive Strength: 22,900 psi, to ASTM C170.
 - 2) Absorption: 0.75 percent, to ASTM C97.
 - 3) Density: 167 lb/ft³, to ASTM C97.
 - 4) Modulus of Rupture: 2,250 psi, to ASTM C99.
 - 5) Flexural Strength: 1,600 psi, to ASTM C880.
 - 6) Abrasion Resistance: 18.0, to ASTM C241.
 - b. Product and Manufacturer's Name: Adair Limestone Tile by Arriscraft.
 - c. Finish: Split Face finish on exposed faces and ends.
 - d. Dimensions:
 - 1) Bed Thickness: 3/4" thick.
 - 2) Unit Length: 23-5/8" long.
 - 3) Unit Height: As Indicated on drawings
 - e. Color and Pattern: Sepia color, Veined pattern, to match approved sample range.
 3. ST-3; Limestone Base Course
 - a. Physical Properties: having the following typical average properties when tested to the identified standard:
 - 1) Compressive Strength: 22,900 psi, to ASTM C170.
 - 2) Absorption: 0.75 percent, to ASTM C97.
 - 3) Density: 167 lb/ft³, to ASTM C97.

- 4) Modulus of Rupture: 2,250 psi, to ASTM C99.
 - 5) Flexural Strength: 1,600 psi, to ASTM C880.
 - 6) Abrasion Resistance: 18.0, to ASTM C241.
 - b. Product and Manufacturer's Name: Adair Limestone Tile by Arriscraft.
 - c. Finish: fine dressed finish on exposed faces and ends.
 - d. Dimensions:
 - 1) Bed Thickness: 3-5/8" thick.
 - 2) Unit Length: 35-5/8" long.
 - 3) Unit Height: 7-5/8" high.
 - e. Color and Pattern: Sepia color, Veined pattern, to match approved sample range.
- B. Mortar: 1:1:6 Portland cement-hydrated lime-sand mix, as specified in Section 042000.
1. For Fully Adhered applications:
 - a. Manufacturer: Laticrete, Inc.
 - 1) Basis of design: MVIS Hi-Bond Veneer Mortar.
- C. Grout: maximum 6,500 psi at 28 days, as specified in Section 042000.
- D. Wall Ties and Anchorages: as specified in Section 042000.
- E. Flashing, Vents, and Masonry Accessories: as specified in Section 042000.

2.3 FABRICATION TOLERANCES

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

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 CUTTING MASONRY UNITS

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

3.3 WETTING MASONRY UNITS

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

3.4 COURSING

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

3.5 PLACING AND BONDING

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

3.6 SITE TOLERANCES

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

3.7 FIELD QUALITY CONTROL

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

3.8 ADJUSTING AND CLEANING

- A. Repair chips on smooth finished units with patch kits furnished by manufacturer.
- B. Clean masonry units as specified in Section 042000.
 - 1. Protect windows, sills, doors, trim and other work from damage.
 - 2. Remove large particles with [stiff fiber brushes] [wood paddles] without damaging surface.
 - 3. Saturate masonry with clean water and flush off loose mortar and dirt.
 - 4. Dilute cleaning agent with clean water in controlled proportions.
 - 5. Apply solution to pre-soaked wall surface using [soft-bristled brush] [low pressure acid-resistant sprayer].

- 6. Thoroughly rinse cleaning solution and residue from wall surface.
- C. Use alternative cleaning solutions and methods for difficult to clean masonry only after consultation with masonry unit manufacturer.

3.9 PROTECTION

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

END OF SECTION 047313

SECTION 051200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

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

1.2 DEFINITIONS

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

1.3 PREINSTALLATION MEETINGS

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

1.4 ACTION SUBMITTALS

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

1.5 INFORMATIONAL SUBMITTALS

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

1.6 QUALITY ASSURANCE

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

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

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

2.2 STRUCTURAL-STEEL MATERIALS

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

2.3 BOLTS, CONNECTORS, AND ANCHORS

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

2.4 PRIMER

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

2.5 GROUT

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

2.6 FABRICATION

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

2.7 SHOP CONNECTIONS

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

2.8 SHOP PRIMING

- A. Shop prime steel surfaces except the following:
 - 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches (50 mm).
 - 2. Surfaces to be field welded.
 - 3. Surfaces of high-strength bolted, slip-critical connections.
 - 4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
 - 5. Galvanized surfaces.
 - 6. Surfaces enclosed in interior construction.
- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
 - 1. SSPC-SP 1 "Solvent Cleaning"
 - 2. SSPC-SP 2, "Hand Tool Cleaning."
 - 3. SSPC-SP 3, "Power Tool Cleaning."
 - 4. SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."
 - 5. SSPC-SP-15: "Commercial Grade Power Tool Cleaning"

- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

2.9 SOURCE QUALITY CONTROL

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

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 ERECTION

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

3.3 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: Snug tightened or Pretensioned as indicated on the drawings..
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 - 1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
 - 2. Remove backing bars or runoff tab, back gouge, and grind steel smooth.
 - 3. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," for mill material.
 - 4. All weld spatter to be removed and grind steel smooth meeting SSPC-SP-15: "Commercial Grade Power Tool Cleaning" requirements.

3.4 FIELD QUALITY CONTROL

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

END OF SECTION 051200

SECTION 05 1213 ARCHITECTURALLY EXPOSED STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1.3 DEFINITIONS

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

1.4 COORDINATION

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

1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site

1.6 ACTION SUBMITTALS

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

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

1.7 INFORMATIONAL SUBMITTALS

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

1.8 QUALITY ASSURANCE

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

1.9 DELIVERY, STORAGE, AND HANDLING

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

1.10 FIELD CONDITIONS

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

PART 2 - PRODUCTS

2.1 BOLTS, CONNECTORS, AND ANCHORS

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

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

2.2 FILLER

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

2.3 PRIMER

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

2.4 FABRICATION

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

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

2.5 SHOP CONNECTIONS

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

2.6 SHOP PRIMING

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

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

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

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

3.3 ERECTION

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

3.4 FIELD CONNECTIONS

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

3.5 FIELD QUALITY CONTROL

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

3.6 REPAIRS AND PROTECTION

- A. Remove welded tabs that were used for attaching temporary bracing and safety cabling and that are exposed to view in the completed Work. Grind steel smooth.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.
- C. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
- D. Clean and prepare surfaces by SSPC-SP 15 Commercial power-tool cleaning.
- E. Touchup Painting: Cleaning and touchup painting are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
- F. Touchup Priming: Cleaning and touchup priming are specified in Section 099600 "High-Performance Coatings."

END OF SECTION 05 1213

SECTION 052100 - STEEL JOIST FRAMING

PART 1 - GENERAL

1.1 SUMMARY

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

1.2 ACTION SUBMITTALS

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

1.3 INFORMATIONAL SUBMITTALS

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

1.4 QUALITY ASSURANCE

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

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle joists as recommended in SJI's "Specifications."
- B. Protect joists from corrosion, deformation, and other damage during delivery, storage, and handling.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

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

2.2 K-SERIES STEEL JOISTS

- A. Manufacture steel joists of type indicated according to "Standard Specification for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members, underslung ends, and parallel top chord.
- B. Steel Joist Substitutes: Manufacture according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle or -channel members.
- C. Provide holes in chord members for connecting and securing other construction to joists.
- D. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches (1:48).

2.3 PRIMERS

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

2.4 JOIST ACCESSORIES

- A. Bridging: Provide bridging anchors and number of rows of horizontal or diagonal bridging of material, size, and type required by SJI's "Specifications" for type of joist, chord size, spacing, and span. Furnish additional erection bridging if required for stability.
- B. Furnish ceiling extensions, either extended bottom-chord elements or a separate extension unit of enough strength to support ceiling construction. Extend ends to within 1/2 inch (13 mm) of finished wall surface unless otherwise indicated.
- C. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy hex steel structural bolts; ASTM A 563 (ASTM A 563M) heavy hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M) hardened carbon-steel washers.
 - 1. Finish: Plain
- D. Furnish miscellaneous accessories including splice plates and bolts required by joist manufacturer to complete joist assembly.

2.5 CLEANING AND SHOP PAINTING

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

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Do not install joists until supporting construction is in place and secured.
- B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications," joist manufacturer's written instructions, and requirements in this Section.
 - 1. Before installation, splice joists delivered to Project site in more than one piece.
 - 2. Space, adjust, and align joists accurately in location before permanently fastening.
 - 3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.
- C. Field weld joists to supporting steel bearing plates and framework. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
- D. Bolt joists to supporting steel framework using high-strength structural bolts. Comply with RCSC's "Specification for Structural Joints Using ASTM A 325 or ASTM A 490 Bolts" for high-strength structural bolt installation and tightening requirements.
- E. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

3.2 FIELD QUALITY CONTROL

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

END OF SECTION 052100

SECTION 053100 - STEEL DECKING

PART 1 - GENERAL

1.1 SUMMARY

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

1.2 ACTION SUBMITTALS

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

1.3 INFORMATIONAL SUBMITTALS

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

1.4 QUALITY ASSURANCE

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

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

2.2 ROOF DECK

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

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

2.3 ACCESSORIES

- A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
- B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.
- C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 (4.8-mm) minimum diameter.
- D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.
- E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi (230 MPa), not less than 0.0359-inch (0.91-mm) design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.
- F. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch (1.90 mm) thick, of same material and finish as deck. For drains, cut holes in the field.
- G. Galvanizing Repair Paint: ASTM A 780/A 780M.
- H. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

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

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

3.2 FIELD QUALITY CONTROL

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

3.3 PROTECTION

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

END OF SECTION 053100

SECTION 054000 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

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

1.2 PREINSTALLATION MEETINGS

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

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

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

1.5 QUALITY ASSURANCE

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

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

2.2 COLD-FORMED STEEL FRAMING MATERIALS

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

2.3 NON-LOAD-BEARING WALL FRAMING

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

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

2.4 FRAMING ACCESSORIES

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

2.5 ANCHORS, CLIPS, AND FASTENERS

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

2.6 MISCELLANEOUS MATERIALS

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

PART 3 - EXECUTION

3.1 PREPARATION

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

3.2 INSTALLATION, GENERAL

- A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.
- B. Install cold-formed steel framing according to AISI S200, AISI S202, and manufacturer's written instructions unless more stringent requirements are indicated.
- C. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.
- D. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.
- E. Install temporary bracing and supports to secure framing and support loads equal to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
- F. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.
- G. Install insulation, specified in Section 072100 "Thermal Insulation," in framing-assembly members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.
- H. Fasten hole-reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

3.3 NON-LOAD-BEARING WALL INSTALLATION

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

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

3.4 ERECTION TOLERANCES

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

3.5 FIELD QUALITY CONTROL

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

3.6 REPAIRS AND PROTECTION

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

END OF SECTION 054000

SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

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

1.2 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

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

2.2 METALS

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

2.3 FASTENERS

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

2.4 MISCELLANEOUS MATERIALS

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

2.5 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Use connections that maintain structural value of joined pieces.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges. Remove sharp or rough areas on exposed surfaces.
- C. Weld corners and seams continuously to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended.
- D. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Locate joints where least conspicuous.
- E. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- F. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors not less than 8 inches (200 mm) from ends and corners of units and 24 inches (600 mm) o.c.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

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

2.7 SHELF ANGLES

- A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4-inch (19-mm) bolts, spaced not more than 6 inches (150 mm) from ends and 24 inches (600 mm) o.c., unless otherwise indicated.
- B. For cavity walls, provide vertical channel brackets to support angles from backup masonry and concrete.
- C. Galvanize shelf angles located in exterior walls.

2.8 METAL LADDERS

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

2.9 LADDER SAFETY CAGES

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

2.10 MISCELLANEOUS STEEL TRIM

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

2.11 METAL BOLLARDS

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

2.12 LOOSE BEARING AND LEVELING PLATES

- A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

2.13 LOOSE STEEL LINTELS

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

2.14 STEEL WELD PLATES AND ANGLES

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

2.15 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes
- B. Finish metal fabrications after assembly.

2.16 STEEL AND IRON FINISHES

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

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

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

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

3.2 INSTALLING BEARING AND LEVELING PLATES

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.
- B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with nonshrink grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.3 INSTALLING METAL BOLLARDS

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

3.4 ADJUSTING AND CLEANING

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

END OF SECTION 055000

SECTION 061053 - MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

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

1.2 ACTION SUBMITTALS

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

1.3 INFORMATIONAL SUBMITTALS

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

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

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

2.2 WOOD-PRESERVATIVE-TREATED MATERIAL

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

2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.

2.3 FIRE-RETARDANT-TREATED MATERIALS

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

2.4 DIMENSION LUMBER FRAMING

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

2.5 MISCELLANEOUS LUMBER

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

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

2.6 PLYWOOD BACKING PANELS

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

2.7 FASTENERS

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

2.8 METAL FRAMING ANCHORS

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

2.9 MISCELLANEOUS MATERIALS

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

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

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

END OF SECTION 061000

SECTION 061600 - SHEATHING

PART 1 - GENERAL

1.1 SUMMARY

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

1.2 ACTION SUBMITTALS

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

1.3 INFORMATIONAL SUBMITTALS

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

1.4 DELIVERY, STORAGE, AND HANDLING

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance Ratings: As tested according to ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.2 PRESERVATIVE-TREATED PLYWOOD

- A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction and Category UC3b for exterior construction.
- B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.
- C. Application: Treat items indicated on Drawings and plywood in contact with masonry or concrete or used with roofing, flashing, vapor barriers, and waterproofing.

2.3 FIRE-RETARDANT-TREATED PLYWOOD

- A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and with

fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

- B. Fire-Retardant-Treated Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.
 - 1. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
 - 2. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201/D 3201M at 92 percent relative humidity. Use where exterior type is not indicated.
 - 3. Design Value Adjustment Factors: Treated lumber plywood shall be tested according to ASTM D 5516 and design value adjustment factors shall be calculated according to ASTM D 6305. Span ratings after treatment shall be not less than span ratings specified.
- C. Kiln-dry material after treatment to a maximum moisture content of 15 percent.
- D. Identify fire-retardant-treated plywood with appropriate classification marking of qualified testing agency.
- E. Application: Treat all plywood unless otherwise indicated.

2.4 GLASS-MAT GYPSUM SHEATHING

- A. Glass-Mat Gypsum Sheathing: ASTM C 1177/1177M.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Georgia-Pacific Corp.
 - b. National Gypsum Co.; Gold Bond Building Products Division.
 - c. USG Corp.; United States Gypsum Co.
 - 2. Type and Thickness: Regular, 1/2 inch (13 mm).
 - 3. Location: All locations unless otherwise indicated.

2.5 WALL SHEATHING

- A. Glass-Mat Gypsum Sheathing: ASTM C 1177/1177M.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Georgia-Pacific Corp.
 - b. National Gypsum Co.; Gold Bond Building Products Division.
 - c. USG Corp.; United States Gypsum Co.
 - 2. Type and Thickness: Regular, 1/2 inch (13 mm).
 - 3. Location: All locations unless otherwise indicated.

2.6 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. For parapet and wall sheathing provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- D. Screws for Fastening Sheathing to Wood Framing: ASTM C 1002.
- E. Screws for Fastening Wood Structural Panels to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.
- F. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached.
 1. For steel framing less than 0.0329 inch (0.835 mm) thick, use screws that comply with ASTM C 1002.
 2. For steel framing from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick, use screws that comply with ASTM C 954.

2.7 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

- A. Sealant for Glass-Mat Gypsum Sheathing: Silicone emulsion sealant complying with ASTM C 834, compatible with sheathing tape and sheathing and recommended by tape and sheathing manufacturers for use with glass-fiber sheathing tape and for covering exposed fasteners.
 1. Sheathing Tape: Self-adhering glass-fiber tape, minimum 2 inches (50 mm) wide, 10 by 10 or 10 by 20 threads/inch (390 by 390 or 390 by 780 threads/m), of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing and with a history of successful in-service use.

2.8 MISCELLANEOUS MATERIALS

- A. Adhesives for Field Gluing Panels to Wood Framing: Formulation complying with APA AFG-01 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.
- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.
- C. Securely attach to substrate by fastening as indicated, complying with the following:
 1. Table 2304.9.1, "Fastening Schedule," in the ICC's International Building Code.
 2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in the ICC's International Residential Code for One- and Two-Family Dwellings.
 3. ICC-ES evaluation report for fastener.

- D. Coordinate wall sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
- E. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

3.2 WOOD STRUCTURAL PANEL INSTALLATION

- A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.
- B. Fastening Methods: Fasten panels as indicated below:
 - 1. Wall Sheathing:
 - a. Screw to cold-formed metal framing.
 - b. Space panels 1/8 inch (3 mm) apart at edges and ends.

3.3 GYPSUM SHEATHING INSTALLATION

- A. Comply with GA-253 and with manufacturer's written instructions.
 - 1. Fasten gypsum sheathing to wood framing with nails or screws.
 - 2. Fasten gypsum sheathing to cold-formed metal framing with screws.
 - 3. Install panels with a 3/8-inch (9.5-mm) gap where non-load-bearing construction abuts structural elements.
 - 4. Install panels with a 1/4-inch (6.4-mm) gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.
- B. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.
- C. Horizontal Installation: Install sheathing with V-grooved edge down and tongue edge up. Interlock tongue with groove to bring long edges in contact with edges of adjacent panels without forcing. Abut ends over centers of studs, and stagger end joints of adjacent panels not less than one stud spacing. Attach at perimeter and within field of panel to each stud.
 - 1. Space fasteners approximately 8 inches (200 mm) o.c. and set back a minimum of 3/8 inch (9.5 mm) from edges and ends of panels.
 - 2. For sheathing under stucco cladding, panels may be initially tacked in place with screws if overlying self-furring metal lath is screw-attached through sheathing to studs immediately after sheathing is installed.
- D. Vertical Installation: Install vertical edges centered over studs. Abut ends and edges with those of adjacent panels. Attach at perimeter and within field of panel to each stud.
 - 1. Space fasteners approximately 8 inches (200 mm) o.c. and set back a minimum of 3/8 inch (9.5 mm) from edges and ends of panels.
 - 2. For sheathing under stucco cladding, panels may be initially tacked in place with screws if overlying self-furring metal lath is screw-attached through sheathing to studs immediately after sheathing is installed.
- E. Seal sheathing joints according to sheathing manufacturer's written instructions.
 - 1. Apply elastomeric sealant to joints and fasteners and trowel flat. Apply sufficient amount of sealant to completely cover joints and fasteners after troweling. Seal other penetrations and openings.
 - 2. Apply glass-fiber sheathing tape to glass-mat gypsum sheathing joints and apply and trowel sealant to embed entire face of tape in sealant. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal other penetrations and openings.

END OF SECTION 061600

SECTION 064023 - INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Solid-surface counter-tops and sills.
 - 2. Plastic-laminate cabinets.
 - 3. Plastic-laminate countertops.
 - 4. Quartz Agglomerate Countertops
 - 5. Interior standing and running trim.
 - 6. Miscellaneous items including:
 - a. Shelving and clothes rod.
 - b. Framing and brackets.
 - c. Floating Shelves.
 - d. Clothing Hook (SP-03).
 - e. Other Items as Indicated on Drawings.
 - 7. Ticket Desk
 - 8. Gift Shop Millwork
 - a. Acrylic Sheet for Display inserts (AS-1)
 - b. Jewelry Case Glass doors
 - 9. Café Desk
- B. Related Sections include the following:
 - 1. Division 6 Section "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing woodwork and concealed within other construction before woodwork installation.

1.2 DEFINITIONS

- A. Interior architectural woodwork includes wood furring, blocking, shims, and hanging strips for installing woodwork items, unless concealed within other construction before woodwork installation.

1.3 SUBMITTALS

- A. Product Data: For particleboard, plywood, high-pressure decorative laminate, adhesive for bonding plastic laminate, fire-retardant-treated materials, cabinet hardware and accessories, and finishing materials and processes.
- B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
 - 1. Show details full size.
 - 2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
 - 3. Show locations and sizes of cutouts and holes for plumbing fixtures and other items installed in architectural woodwork.
- C. Samples for each exposed product and for each color and texture specified.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed architectural woodwork similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Fabricator Qualifications: A firm experienced in producing architectural woodwork similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- C. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" for grades of interior architectural woodwork, construction, finishes, and other requirements.

1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install woodwork until the building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed and indicate measurements on Shop Drawings.
 - 2. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating woodwork without field measurements. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.6 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that interior architectural woodwork can be supported and installed as indicated.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Provide materials that comply with requirements of the AWI quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.
- B. Wood Products: Comply with the following:
 - 1. Wood fabricated from old growth timber is not permitted.
 - 2. Particle Board: ANSI A208.1, Grade M-2.
 - 3. Medium Density Fiberboard (MDF): ANSI A208.2, Grade 130.
 - 4. Hardwood Plywood: HPVA HP-1.
 - 5. Softwood Plywood: PS 1.
 - 6. Fire Retardant Treatment:

- a. Manufacturers:
 - 1) Lonza Group: www.wolmanizedwood.com.
 - 2) Hoover Treated Wood Products, Inc: www.frtw.com.
 - 3) Koppers, Inc: www.koppersperformancechemicals.com.
 - 4) Viance, LLC: www.treatedwood.com.
 - 5) Substitutions: See Section 01 2500 - Substitution Procedures.
 - b. Interior Type A: AWPA U1, Use Category UCFA, Commodity Specification H, low temperature (low hygroscopic) type, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes.
 - 1) Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
7. Preservative Treatment:
- a. Manufacturers:
 - 1) Lonza Group: www.wolmanizedwood.com.
 - 2) Hoover Treated Wood Products, Inc: www.frtw.com.
 - 3) Koppers Performance Chemicals, Inc: www.koppersperformancechemicals.com.
 - 4) Viance, LLC: www.treatedwood.com.
 - 5) Substitutions: See Section 01 2500 - Substitution Procedures.
 - b. Preservative Pressure Treatment of Lumber Above Grade: AWPA U1, Use Category UC3B, Commodity Specification A using waterborne preservative.
 - 1) Kiln dry lumber after treatment to maximum moisture content of 19 percent.
 - 2) Treat lumber in contact with masonry or concrete.
 - 3) Treat lumber in other locations as indicated.
 - c. Preservative Pressure Treatment of Plywood Above Grade: AWPA U1, Use Category UC2 and UC3B, Commodity Specification F using waterborne preservative.
 - 1) Kiln dry plywood after treatment to maximum moisture content of 19 percent.
 - 2) Treat plywood in contact with masonry or concrete.
 - 3) Treat plywood at countertop subtops at sinks or other wet locations.
 - 4) Treat plywood in other locations as indicated.
8. Preservative Pressure Treatment of Lumber in Contact with Soil: AWPA U1, Use Category UC4A, Commodity Specification A using waterborne preservative.
9. Preservative for Field Application to Cut Surfaces: As recommended by manufacturer of factory treatment chemicals for brush-application in the field.
- C. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated, or if not indicated, as required by woodwork quality standard.
1. Manufacturer: As indicated on the drawings.
 - a. Formica Corporation: www.formica.com.
 - b. Panolam Industries International, Inc. Nevamar: www.nevamar.com.

- c. Panolam Industries International, Inc. Pionite:
www.pionitelaminates.com.
- d. Wilsonart: www.wilsonart.com.
- e. Arborite
- f. Substitutions: See Section 01 6000 - Product Requirements
- 2. Colors, Patterns, and Finishes:
 - a. As indicated on drawings.
- D. Adhesive for Bonding Plastic Laminate: Unpigmented contact cement.
- E. Edgebanding: Rigid PVC extrusions, flat shaped, smooth texture, through color with satin finish. Width to match component thickness. Match adjacent laminate in color, pattern, and finish.
 - 1. 0.118 inch (3 mm) thick at doors, drawer fronts, and countertops.
 - 2. 0.039 inch (1 mm) thick elsewhere, including exposed exterior cabinet members, top edges of drawer boxes, adjustable shelves, and interior panels.

2.2 SOLID SURFACE COUNTER-TOP AND SILLS

- A. Solid Surfacing Sheet and Plastic Resin Castings: Complying with ISFA 2-01 and NEMA LD 3; acrylic or polyester resin, mineral filler, and pigments; homogenous and non-porous; no surface coating; color and pattern consistent throughout thickness.
 - 1. Manufacturers:
 - a. E. I. du Pont de Nemours and Company (Dupont); Corian:
www.corian.com,
 - b. Substitutions: See Section 01 2500 - Product Requirements
 - 2. Fabricate tops in one piece with shop-applied backsplashes. Comply with solid-surfacing-material manufacture's written recommendations for adhesives, sealers, fabrication, and finishing.
 - 3. Pattern:
 - a. Manufacturer:
 - 1) Mario Romano Walls / MR Walls
 - 2) Corian
 - b. Design:
 - 1) As indicated on drawings.
 - c. Color:
 - 1) As indicated on drawings

2.3 PLASTIC-LAMINATE CABINETS AND MILLWORK

- A. Quality Standard: Comply with AWI/AWMAC/WI (AWS) requirements for laminate cabinets.
 - 1. Grade: Premium.
 - 2. AWI Type of Cabinet Construction: Flush overlay.
 - 3. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate complying with the following requirements:
 - a. Horizontal Surfaces Other Than Tops: HGS.
 - b. Vertical Surfaces: HGS.

- c. Edges: PVC edge banding, 0.118 inch (3 mm) thick, matching laminate in color, pattern, and finish.
- d. Materials for Semi exposed Surfaces: Provide surface materials indicated below:
 - 1) Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, Grade VGS.
 - 2) Drawer Sides and Backs: Solid-hardwood lumber.
 - 3) Drawer Bottoms: Hardwood plywood.
- e. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
 - 1) As indicated on Drawings.

2.4 CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets, except for items specified in Division 8 Section "Door Hardware".
- B. Hardware Standard: Comply with BHMA A156.9 for items indicated by referencing BHMA numbers or items referenced to this standard.
- C. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 170 degrees of opening, self-closing.
 - 1. Provide minimum two hinges per door.
 - 2. Provide a minimum of three hinges for doors over 36 inches tall.
 - 3. Provide a minimum of four hinges for doors over 60 inches tall.
- D. Pulls: J-Profile for $\frac{3}{4}$ " panel, Satin Aluminum finish.
- E. Catches: Magnetic catches, BHMA A156.9, B03141.
- F. Adjustable Shelf Standards and Supports: BHMA A156.9, B04071; with shelf rests, B04081 and BHMA A156.9, B04102; with shelf brackets, B04112.
 - 1. 32 MM system is also acceptable.
 - 2. All supports to be metal unless otherwise noted.
- G. Shelf Rests: BHMA A156.9, B04013.
- H. Drawer Slides: Side-mounted, full-extension, zinc-plated steel drawer slides with steel ball bearings, BHMA A156.9, B05091, and rated for the following loads:
 - 1. Box Drawer Slides: 75 lbf.
- I. Door Locks: BHMA A156.11, E07121.
- J. Drawer Locks: BHMA A156.11, E07041.
- K. Grommets for Cable Passage through Countertops: 2-inch OD, molded-plastic grommets and matching plastic caps with slot for wire passage. Color as selected from manufactures standard colors.
- L. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
 - 1. Satin Chromium Plated: BHMA 626 for brass or bronze base; BHMA 652 for steel base.
- M. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.
- N. Pass-through Doors:
 - 1. Double Action Spring Hinge

2.5 PLASTIC-LAMINATE COUNTERTOPS

- A. Quality Standard: Comply with AWI Section 400 requirements for high-pressure decorative laminate countertops.
- B. Grade: Premium.
- C. High-Pressure Decorative Laminate Grade: HGS.
- D. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
 - 1. As indicated on Drawings.
- E. Edge Treatment: Same as laminate cladding on horizontal surfaces.
- F. Core Material: Particleboard made with exterior glue.
- G. Core Material at Sinks: Particleboard made with exterior glue.

2.6 QUARTZ AGGLOMERATE COUNTERTOP MATERIALS

- A. Quartz Agglomerate: Solid sheets consisting of quartz aggregates bound together with a matrix of filled plastic resin and complying with ICPA SS-1, except for composition.
 - 1. Manufacturer:
 - a. Basis of design: Silestone
 - b. Substitutions: See Section 012500
 - 2. Colors and Patterns: As indicated in Drawings on Interior Materials Legend.
 - 3. Particleboard: ANSI A208.1, Grade M-2 and Grade M-2-Exterior Glue at wet areas.
 - 4. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.

B. COUNTERTOP FABRICATION

- 1. Fabricate countertops according to quartz agglomerate manufacturer's written instructions and the AWI/AWMAC/WI's "Architectural Woodwork Standards."
 - a. Grade: Premium.
- 2. Countertops: 3 CM solid quartz.
 - a. Joints: Fabricate countertops in sections for joining in field.
 - 1) Joint Locations: Not within 18 inches (450 mm) of a sink or cooktop and not where a countertop section less than 36 inches (900 mm) long would result, unless unavoidable.
 - 2) Joint Type, Bonded: 1/32 inch (0.8 mm) or less in width.
- 3. Holes:
 - a. Provide smooth and even holes as indicated on drawings for electrical cords.
 - b. Grommets: Zinc die cast grommet, Satin Nickle. Minimum 1 ½" cut out diameter.

C. INSTALLATION MATERIALS

- 1. Adhesive: Product recommended by quartz agglomerate manufacturer.
- 2. Sealant for Countertops: Comply with applicable requirements in Section 079200 "Joint Sealants."

2.7 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln-dried to less than 15 percent moisture content.
- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on the inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.
- C. Glue: Aliphatic resin, polyurethane, or resorcinol wood glue recommended by manufacturers for general carpentry use.
- D. Multipurpose Construction Adhesive: Formulation complying with ASTM D 3498 that is recommended for indicated use by adhesive manufacturers. Do not use adhesives that contain urea formaldehyde.
- E. Workstation Countertop Support Brackets: Provide brackets as indicated on Drawings.
 - 1. Space brackets at maximum 36" centers.
 - 2. See drawings for additional information and details.
- F. Shelf, Shelf Rods and Brackets
 - 1. Basis of Design: Knappe and Vogt Mfg. Co. closet rod and brackets
 - a. Provide wall flanges, end caps, fasteners and anchors for a complete system
 - 2. Shelf Bracket: Model 1195 Heavy duty series
 - a. 12 Gauge steel construction
 - b. 11" shelf platform
 - c. Accepts up to 1-3/8" rod
 - 3. Rod: Round Closet Rod Tubing, Outside Diameter: 1-5/16 inches (27 mm):
 - a. Model 750 5: 2.0 mm wall thickness; inside diameter: 1-5/32 inch (29 mm);
 - b. Finish: Brilliant Chrome; premium double-plated finish, seamless, pit-free.
 - c. Length: as indicated on drawings
 - 4. Shelf: Heavy-Duty All-Purpose Shelf Boards: Heavy-Duty 1980 All Purpose Shelf Boards consist of 5/8 inch (16 mm) thick shelf board with square corners.
 - a. Color: White
 - b. Size: 12" wide by length indicated on drawings
- G. Floating Shelves - Front Kitchen
 - 1. Suspended shelf bracket
 - a. Federal Brace floating shelf support rod bracket
 - 2. Shelf
 - a. As indicated on drawings.
- H. Coat/Robe hook (SP-03).
 - 1. Basis of Design Products: Bradley (9B1 Series) Elvari Double (02) Coat/Robe Hook
 - a. 14 gauge, 300 series stainless steel in a brushed #3 satin finish.
 - b. Fasteners, set screws, and hex key included.

- c. Overall dimensions- Double Hook: 5-3/8"H x 1-3/16"W x 1-3/4"D
 - d. No visible welds or mounting hardware.
 - e. Surface Mounted.
 - f. Refer to Standard Mounting Heights and elevations for installation.
2. Substitutions: The Architect will consider products of comparable manufacturers as a substitution, pending the contractor's submission of adequate documentation of the substitution in accordance with procedures in Division 1 of the Project Manual. See Section 012500 - Substitution Procedures.

2.8 TICKET DESK

- A. Quality Standard: Comply with AWI/AWMAC/WI (AWS) requirements for laminate cabinets.
1. Grade: Premium.
 2. AWI Type of Cabinet Construction: Flush overlay.
 - a. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate complying with the following requirements:
 3. Horizontal Surfaces Other Than Tops: HGS.
 4. Vertical Surfaces: HGS.
 5. Edges: PVC edge banding, 0.118 inch (3 mm) thick, matching laminate in color, pattern, and finish.
 6. Materials for Semi exposed Surfaces: Provide surface materials indicated below:
 - a. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, Grade VGS.
 - b. Drawer Sides and Backs: Solid-hardwood lumber.
 - c. Drawer Bottoms: Hardwood plywood.
 7. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
 - a. As indicated on Drawings.

2.9 GIFT SHOP MILLWORK

- A. Quality Standard: Comply with AWI/AWMAC/WI (AWS) requirements for laminate cabinets.
1. Grade: Premium.
 2. AWI Type of Cabinet Construction: Flush overlay.
 - a. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate complying with the following requirements:
 3. Horizontal Surfaces Other Than Tops: HGS.
 4. Vertical Surfaces: HGS.
 5. Edges: PVC edge banding, 0.118 inch (3 mm) thick, matching laminate in color, pattern, and finish.
 6. Materials for Semi exposed Surfaces: Provide surface materials indicated below:

- a. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, Grade VGS.
 - b. Drawer Sides and Backs: Solid-hardwood lumber.
 - c. Drawer Bottoms: Hardwood plywood.
7. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
- a. As indicated on Drawings.
8. Acrylic Sheet (AS-1):
- a. ¼" Cast Acrylic
 - b. Color: Tinted. Color to be chosen from manufacturer's standard colors.
 - c. Finish: P95 matte
9. Jewelry Glass Display Case Doors: CRL (CR Laurence) Blumcraft Satin anodized locking double door with mounting bars; ½" tempered glass.
- a. As indicated on Drawings.

2.10 CAFÉ DESK

- A. Quality Standard: Comply with AWI/AWMAC/WI (AWS) requirements for laminate cabinets.
1. Grade: Premium.
 2. AWI Type of Cabinet Construction: Flush overlay.
 - a. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate complying with the following requirements:
 3. Horizontal Surfaces Other Than Tops: HGS.
 4. Vertical Surfaces: HGS.
 5. Edges: PVC edge banding, 0.118 inch (3 mm) thick, matching laminate in color, pattern, and finish.
 6. Materials for Semi exposed Surfaces: Provide surface materials indicated below:
 - a. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, Grade VGS.
 - b. Drawer Sides and Backs: Solid-hardwood lumber.
 - c. Drawer Bottoms: Hardwood plywood.
 7. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
 - a. As indicated on Drawings.

2.11 FABRICATION, GENERAL

- A. Interior Woodwork Grade: Provide Premium grade interior woodwork complying with the referenced quality standard.
- B. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.
- C. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:

- D. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible, before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
 - 1. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements indicated on Shop Drawings before disassembling for shipment.
- E. Shop cut openings, to the maximum extent possible, to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burs.
 - 1. Seal edges of openings in countertops with a coat of varnish.
- F. Fabricate to AWI premium standards.
- G. Sand work smooth and set exposed nails and screws.
- H. Field Applied Opaque Finishes:
 - 1. Apply wood filler in exposed nail and screw indentations and sand smooth.
 - 2. Shop prime with one coat of wood primer as specified in Section 09 9123 - Interior Painting.
 - 3. Refer to Section 09 9100 - Painting for field painting.
- I. Shop Applied Transparent Finishes:
 - 1. On items to receive transparent finishes, use wood filler matching or blending with surrounding surfaces and of types recommended for applied finishes.
 - 2. Finish work in accordance with AWI/AWMAC/WI (AWS), Section 5 - Finishing for grade specified and as follows:
 - a. Transparent Finishes:
 - 1) Provide one of the following finishes:
 - i. System - 5, Varnish, Conversion.
 - ii. System - 9, UV Curable, Acrylated Epoxy, Polyester or Urethane.
 - iii. System - 10, UV Curable, Water-based.
 - iv. System - 11, Polyurethane, Catalyzed.
 - 2) Stain: To match Architect's samples.
 - 3) Sheen: Satin.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Condition woodwork to average prevailing humidity conditions in installation areas before installation.
- B. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing.

3.2 INSTALLATION

- A. Quality Standard: Install woodwork to comply with AWI Section 1700 for the same grade specified in Part 2 of this Section for type of woodwork involved.
- B. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches.
- C. Scribe and cut woodwork to fit adjoining work and refinish cut surfaces and repair damaged finish at cuts.
- D. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation.
- E. Standing and Running Trim: Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to the greatest extent possible. Do not use pieces less than 96 inches (2400 mm) long except where shorter single-length pieces are necessary.
 - 1. Scarf running joints and stagger in adjacent and related members.
 - 2. Filling with wood filler is more labor intensive than filling with latex sealant.
 - 3. Fill gaps, if any, between top of base and wall with [plastic wood filler; sand smooth; and finish same as wood base if finished] [latex sealant, painted to match wall].
 - 4. Install standing and running trim with no more variation from a straight line than 1/8 inch in 96 inches (3 mm in 2400 mm).
- F. Cabinets: Install without distortion so doors and drawers' fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
 - 1. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
 - 2. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches o.c. with
- G. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
 - 1. Install countertops with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
 - 2. Secure backsplashes to tops with concealed metal brackets at 16 inches o.c. and to walls with adhesive.
 - 3. Calk space between backsplash and wall with sealant specified in Division 7 Section "Joint Sealants."
 - 4. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Pre-drill holes for screws as recommended by manufacturer.
 - 5. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.
 - 6. Secure countertops to subtops with adhesive according to quartz agglomerate manufacturer's written instructions.
 - 7. Bond joints with adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.
 - 8. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items

to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.

3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; where it is not possible to repair, replace woodwork. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware.
- C. Touch up finishing work specified in this Section after installation of interior architectural woodwork. Fill nail holes with matching filler where exposed
- D. Clean woodwork on exposed and semi-exposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION 064023

SECTION 07 1113 - BITUMINOUS DAMPPROOFING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Bituminous dampproofing.
- B. Protection boards.

1.2 REFERENCE STANDARDS

- A. ASTM D1187/D1187M - Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal 1997 (Reapproved 2018).
- B. ASTM D1227/D1227M - Standard Specification for Emulsified Asphalt Used as a Protective Coating for Roofing 2013, with Editorial Revision (2019).
- C. ASTM D1227 - Standard Specification for Emulsified Asphalt Used as a Protective Coating for Roofing 2013.

1.3 SUBMITTALS

- A. Product Data: Provide properties of primer, bitumen, and mastics.
- B. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing the work of this section with at least 5 years of documented experience.

1.5 FIELD CONDITIONS

- A. Maintain ambient temperatures above 40 degrees F for 24 hours before and during application until dampproofing has cured.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers:
 - 1. BASF Corp., Master Builders Solutions; www.master-builders-solutions.basf.us.
 - 2. Carlisle Coatings and Waterproofing; www.carlisleccw.com.
 - 3. The Euclid Chemical Company; www.euclidchemical.com.
 - 4. Henry Corp.; www.henry.com.
 - 5. Karnak Corp.; www.karnakcorp.com.
 - 6. Lambert Corp.; www.lambertusa.net.
 - 7. W. R. Meadows, Inc.; www.wrmeadows.com.
 - 8. Substitutions: See Section 01 2500 - Substitution Procedures.
 - 9. Bituminous Dampproofing: Cold-applied water-based emulsion; asphalt with mineral colloid or chemical emulsifying agent; with or without fiber

reinforcement; asbestos-free; suitable for application on vertical and horizontal surfaces.

10. Composition - Vertical Application: ASTM D1227/D1227M Type III or ASTM D1187/D1187M Type I.
11. Composition - Horizontal and Low-Slope Application: ASTM D1227/D1227M Type II or III.
12. VOC Content: Not more than permitted by local, State, and federal regulations.
13. Applied Thickness: 1/16 inch, minimum, wet film.
14. Primers, Mastics, and Related Materials: Type as recommended by dampproofing manufacturer.

2.2 ACCESSORIES

- A. Protection Board: 1/8 inch thick bitumen impregnated glass fiberboard.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions are acceptable prior to starting this work.
- B. Verify substrate surfaces are durable, free of matter detrimental to adhesion or application of dampproofing system.
- C. Verify that items penetrating surfaces to receive dampproofing are securely installed.

3.2 PREPARATION

- A. Protect adjacent surfaces not designated to receive dampproofing.
- B. Clean and prepare surfaces to receive dampproofing in accordance with manufacturer's instructions.
- C. Do not apply dampproofing to surfaces unacceptable to manufacturer.
- D. Apply mastic to seal penetrations, small cracks, or minor honeycombs in substrate.

3.3 APPLICATION

- A. Perform this work in accordance with manufacturer's instructions and NRCA (WM) applicable requirements.
- B. Prime surfaces in accordance with manufacturer's instructions and NRCA (WM) applicable requirements.
- C. Prime surfaces at a rate approved by manufacturer for application indicated, and allow primer to dry thoroughly.
- D. Apply bitumen with roller or spray application; apply two coats.
- E. Seal items watertight with mastic, that project through dampproofing surface.
- F. Place protection board directly over dampproofing, butt joints, and adhere to tacky dampproofing.
- G. Scribe and cut boards around projections, penetrations, and interruptions.

END OF SECTION - 071113

SECTION 07 2100 - THERMAX WALL SYSTEM

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. THERMAX Wall System Foam on Structure Assembly; consisting of the following to form a continuous thermal, air, and water barrier system to complete a continuous thermal, air, and water barrier system:
 - 1. Rigid foil faced polyisocyanurate (ISO) board insulation.
 - 2. Seam Treatment

1.2 RELATED REQUIREMENTS

- A. 072119 - Foamed In Place Insulation.

1.3 REFERENCE STANDARDS

- A. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness; 2015.
- B. ASTM C1029 - Standard Specification for Spray-Applied Rigid Cellular Polyurethane Thermal Insulation; 2015.
- C. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2016.
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2016.
- E. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2016).
- F. ASTM E2357 - Standard Test Method for Determining Air Leakage of Air Barrier Assemblies; 2011.
- G. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components; 2012.

1.4 SUBMITTALS

- B. Product Data: Provide data on product characteristics for each type of product indicated.
- C. NFPA 285 Compliance: Submit third party documentation showing wall assembly compliance with NFPA 285.

1.5 QUALITY ASSURANCE

- A. Pre-installation Meeting: Prior to commencement of application of wall system, review and document methods and procedures related to installation, including the following:
 - 1. Participants: Authorized representative of the Contractor, Architect, Applicator, and Manufacturer.
 - 2. Review metal wall framing assemblies for potential interference and conflicts and coordinate layout and support provisions for interfacing work.
 - 3. Review insulated sheathing, seam treatment, [and spray polyurethane foam] methods and procedures related to application including manufacturer's installation guidelines.
 - 4. Review construction schedule and confirm availability of products, applicator personnel, equipment, and facilities.



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5. Review governing regulatory requirements, and requirements for insurance and certificates as applicable.
 6. Review field quality control procedures.
 - B. Spray Polyurethane Foam (SPF) Installer Qualifications: Company specializing in performing SPF work of the type specified and with at least three years of documented experience and certified by manufacturer.
 - C. Comply with manufacturer's recommendations for the proper storage and handling of materials.
- 1.6 MOCK-UP
- A. Provide mock-up of specified system, illustrating proper installation of specified wall assembly in compliance with manufacturer's recommendations.
- 1.7 FIELD CONDITIONS
- A. Installation Temperatures: Comply with manufacturer's recommendations for temperatures during product installation.
- 1.8 WARRANTY
- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
 - B. DuPont™ Thermax™ Wall System (TWS)*; Foam on Structure: Register project for Gold System Warranty (20 Yr Thermal, 15 Yr Water Resistance, 6 Mo. Exposure when using DuPont™ Thermax™ XARMOR™ (ci) Exterior Insulation and DuPont™ LiquidArmor™ Flashing and Sealant*).
 - C. DuPont™ Thermax™ Wall System (TWS)*; Foam on Gypsum: Provide Manufacturer's Limited Thermal Warranty for polyisocyanurate insulation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Thermal performance:
 1. Exterior insulation: ASTM C518, Stabilized R-value of minimum 6.0 per inch with a six month exposure capacity to outdoor elements and 15 year thermal warranty.
 - a. Code compliance: Class A (≤ 25 Flame Spread Index and < 450 Smoke Developed Index) for both core AND finished product classified at max thickness per UL 723 criteria or ASTM E84 criteria.
 - b. Fire propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
 2. Interior spray polyurethane foam: ASTM C518, 140 degree F/90 day Aged R-value (measured at 75 degree F mean temperature), for product with a minimum 45 degree F ambient and substrate application temperature is R6.4 per inch and 140 degree F/90 day Aged R-value (measured at 75 degree F mean temperature), for product with a minimum 30 degree F ambient and substrate application temperature is R6.0 per inch.
 - a. Core density: ASTM D1622, Minimum 2.0 pcf.
 - b. Acceptable adhesion to substrate based on specific minimum application temperature and proper substrate conditions.



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- B. Air Barrier: Tested in accordance with ASTM E2357 at pressure of 6.24 psf (300 Pa) or greater, with air infiltration less than 0.04 cfm/sq ft (0.2 L/sq m) of fixed wall area.
 - 1. Conduct testing at positive and negative sustained wind loading of 12.5 psf (0.6 kPa) for one-hour duration in each direction.
 - 2. Provide pressure cycling of wall at 2000 cycles in both positive and negative directions, ending with wind gust loading at 25 psf (1.2 kPa).
- C. Water Penetration: Tested in accordance with ASTM E331, with minimum pressure differential of 6.24 psf (300 Pa) for at least two hour test duration without any uncontrolled water penetration.

2.2 THERMAX™ - FOAM ON STRUCTURE WALL INSULATION SYSTEM

- A. Provide foam on foam wall insulation system that controls thermal, air, vapor, and water penetration, and provides continuity of building envelope enclosure.
 - 1. Provide insulated sheathing on exterior of metal wall framing assembly.
 - 2. Provide joint, penetration and gap sealing material for sealing component joints, penetrations through wall system and gaps between building envelope enclosure components at other building interfaces.
 - 3. Provide spray polyurethane foam (SPF) insulation in stud cavity.
- B. Polyisocyanurate (ISO) Board Insulation with Foil Facers on Both Sides: Complies with ASTM C1289, Type I; Class 2 glass fiber reinforced core foam.
 - 1. Basis of Design:
 - a. DuPont de Nemours Inc.; DuPont™ Thermax XARMOR™ (ci) Exterior Insulation*
(4 mil gray front facer, 1.25 mil embossed aluminum back facer)
 - 2. Flame Spread Index (FSI): Class A - 0 to 25 for both core AND finished product, when tested in accordance with ASTM E84.
 - 3. Smoke Developed Index (SDI): 450 or less for both core AND finished product, when tested in accordance with ASTM E84.
 - 4. Compressive Resistance: At least 25 psi (173 kPa).
 - 5. Water Vapor Permeance: Maximum of 0.04 perms (2.29 ng/Pa sec sq m) per 1 inch (25.4 mm) thickness.
 - 6. Water Absorption: Maximum of 0.1% by volume by total immersion.
 - 7. Board Overall Dimensions: 48 inches (1.22 m) wide by 96 inches (2.44 m) long.
 - 8. Board Thickness: Nominal thickness as indicated on drawings.
 - a. Edge Treatment: Shiplap edge at long side on 1.5" and greater thicknesses.
 - 9. Front Facer: 4.0 mil gray embossed aluminum
 - 10. Back Facer: 1.25 mil embossed aluminum
 - 11. Thermal Resistance (R-value): Minimum 6 per inch at 75 degrees F (24 degrees C) and minimum 6.6 per inch at 40 degrees F (5 degrees C) in accordance with ASTM C1289.
- C. Stud Cavity Foam Insulation (optional component): Provide two component, closed-cell spray polyurethane foam (SPF) insulation applied to interior face of board insulation wall sheathing and interior studs, complies with ASTM C1029.
 - 1. Assembly, including spray polyurethane foam, must comply with NFPA 285. Refer to requirements in part 1.04.C. of this section.
 - 2. Acceptable Products:
 - a. BASF; SPRAYTITE 81206.



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2.3 ACCESSORIES

- A. Foam Sealant Penetration Filler: Provide single component spray polyurethane foam (SPF) for sealing wall penetrations through board insulation.
 - 1. Products: DuPont™ Great Stuff Pro™ Gaps and Cracks* single component polyurethane low-pressure sealant or DuPont™ Great Stuff Pro™ Window and Door* single component polyurethane low-pressure foam sealant as manufactured by DuPont de Nemours Inc..
- B. Facer Repair Flashing: Provide board insulation manufacturer's recommended flashing for repair of damaged board insulation facer.
 - 1. Products: DuPont™ LiquidArmor™ CM Flashing and Sealant*, LiquidArmor™ QS Flashing and Sealant*, or LiquidArmor™ LT Flashing and Sealant* as manufactured by DuPont de Nemours Inc..
- C. Flashing and Sealant: Provide for sealing joints, seams and veneer tie penetrations through board insulation.
 - 1. Spray applied elastomeric liquid flashing and sealant, grey-blue color.
 - a. Product: DuPont™ LiquidArmor™ CM Flashing and Sealant* (acrylic based formulation, spray or brush application) as manufactured by DuPont de Nemours Inc..
 - b. Product: DuPont™ LiquidArmor™ QS Flashing and Sealant* (acrylic based formulation, spray or brush application) as manufactured by DuPont de Nemours Inc..
 - 2. Trowel applied single component silicone flashing and sealant, gray color.
 - a. Product: DuPont™ LiquidArmor™ LT Flashing and Sealant* (silicone based formulation, trowel or caulk application) as manufactured by DuPont de Nemours Inc..
 - 3. Joint Flashing Tape: Provide for sealing joints, seams and veneer tie penetrations through board insulation as recommended by manufacturer.
- D. Fasteners: Board insulation manufacturer's recommended polymer or other corrosion protected steel screw with washer for fastening insulation sheathing to CMU substrate; ASTM C954.
 - 1. Provide fastener length and size as required for board insulation sheathing thickness.
 - 2. Provide fastener along placement of base flashing as necessary.
 - 3. Product: Grip-Deck Self-Drilling Ceramic Coated Screws by TRUFAST Walls (formerly Rodenhouse, Inc.).
- E. Washer: Provide 2 inch (51 mm) diameter plastic washers for each screw fastener.
 - 1. Product: Thermal-Grip ci prong washer by TRUFAST Walls (formerly Rodenhouse, Inc.).
- F. Sill Plate Seal: Provide flexible polyethylene foam gasketing strip between top of foundation and sill plate.
 - 1. Product: DuPont™ Styrofoam™ Brand Sill Seal Foam Gasket* as manufactured by DuPont de Nemours Inc..
- G. Roof/Wall Juncture Sealing
 - 1. Maintain continuity of air barrier by sealing the roof/wall juncture.
 - 2. Acceptable Products:
 - a. DuPont de Nemours Inc.; DuPont™ Froth-Pak™ Foam Insulation* (Class A).



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- I. Self-Adhering Transition Flashing: Provide for through-wall flashing, roof-to-wall transitions, parapet transitions, above window kick-outs, wall to below-grade transitions, wall offsets, rough window openings, balcony transitions.
 1. Product: DuPont™ DuraGard™ CM Transition Flashing as manufactured by DuPont de Nemours Inc..

PART 3 - EXECUTION

3.1 INSTALLATION, DUPONT™ THERMAX™ BRAND- FOAM ON STRUCTURE WALL INSULATION SYSTEM

- A. Comply with foil faced polyisocyanurate (ISO) board insulation and spray polyurethane foam (SPF) Manufacturer's installation instructions and details for applications indicated.
- B. Foil Faced Polyisocyanurate (ISO) Board Insulation:
 1. Fasten board insulation to exterior face of metal stud wall framing using insulation sheathing and manufacturer's recommended screw fastener type and length with washers.
 2. Install board insulation panels tightly to each other and around openings and penetrations.
 3. Install insulation sheathing panels horizontally with embossed aluminum foil facer to exterior side.
 - a. Use panels having maximum length to minimize number of joints.
 - b. Locate vertical edge joints parallel to and centered over support framing.
 - c. Provide additional support framing wherever panel edge joints do not bear against metal stud framing or sill plate.
 4. Fasten panels to support framing with fasteners spaced at maximum of 12 inch (305 mm) on center at wall perimeter, and at maximum of 16 inch (406 mm) on center at panel field.
 - a. Set perimeter fasteners back from edge of insulation panels at least 3/8 inch (9.5 mm).
 - b. Drive fasteners to bear tight and flush with surface of insulation panel.
 - c. Maximum of two board joints may be bridged per fastener.
 5. Install flashing along perimeter edge joints of insulation panels.
 6. Install flashing at wall tie penetrations and other mechanical fastening assemblies of insulation panels.
 7. Install facer repair flashing along top edge of base flashing applied to insulation panel, that may also include termination bar, running horizontally along top edge of flashing and lapped over top edge of base.
 - a. Provide flat strap in framing at termination bar height to allow for proper fastening of termination bar.

3.2 INSTALLATION, GENERAL

- A. Spray Polyurethane Foam (SPF) Insulation:
 1. Comply with spray polyurethane foam Manufacturer's installation instructions.
- B. Flashing and Sealant:
 1. Apply material within application limits of product manufacturer.
 2. Do not apply product on surfaces with standing water or frost.
 3. Avoid installing on days with a high probability of significant rainfall.



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4. Seal gaps greater than 1/4 inch (6.4 mm) in width with penetration filler prior to applying flashing and sealant.
 - a. If facer on board insulation is damaged, make note of affected area and apply additional spray over damaged area.
 - b. Replace damaged insulation, or repair facer flaws with appropriate flashing as recommended by insulation panel manufacturer.
5. Apply flashing and sealant to board joints, penetrations and other fenestration openings as required at material required application thickness.
 - a. Apply flashing 3 inches (76 mm), plus or minus 1 inch (25.4 mm) wide over board insulation joints, with at least 1 inch (25.4 mm) of spray covers each side of joint.
 - b. Apply flashing over fasteners and washers along board insulation joints.
 - c. Apply flashing over/under cladding girts and fasteners per insulation panel manufacturers guidelines.
 - d. Install façade attachment system after flashing has been applied.
6. Rough Openings: Apply flashing and sealant at least 3 inches (76 mm) onto face of insulation panel sheathing, and completely cover edge of insulation board; also spray at least 3 inch (76 mm) back onto rough opening substrate.
 - a. It is recommended to cover back onto rough opening at least 1 inch past the interior weatherseal.
7. Board Insulation or Substrate Penetrations: Apply flashing and sealant at least 2 inches (51 mm) onto face of insulation sheathing and at least 2 inches (51 mm) onto penetration or primary flashing substrate.
8. Use wet mil thickness gauge to ensure proper installation thickness.
 - a. Where consistently below minimum thickness, apply another layer to achieve proper thickness requirements.
9. Visually inspect for any areas missed and trowel on sealant as necessary.

3.3 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Submit spray polyurethane foam (SPF) field inspection and test reports for the following:
 1. Installer shall complete daily work record and record other required information including results of completed testing.
 - a. Maintain copies of daily work record on site for routine inspection.
 - b. Provide copies of daily work record to insulation system manufacturer, Owner or Owner's Representative upon request.
 2. Contractor is responsible for maintaining daily work record of any required testing and inspections.
 3. Upon Owner's request, provide site inspections by qualified third party inspector.
 - a. Include frequency and cost of inspections as designated by Owner.
 - b. Upon defects being revealed from site inspections, the Contractor shall immediately rectify these defects at their cost.
 4. Installer's daily work record shall verify conformance with manufacturer's installation instructions, and specified requirements.



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3.4 PROTECTION

- A. Protect polyisocyanurate rigid foam board insulation from excess moisture, mechanical damage, and exposure to open flame.
- B. Promptly Repair damage caused to board insulation in a manner that retains integrity and continuity of insulation and facer materials.
- C. Keep polyisocyanurate board insulation dry and above water on jobsite, and cover with tarp until ready for installation.
- D. Promptly cover board insulation with cladding; within maximum of 180 days after installation for DuPont™ Thermax™ XARMOR™ (ci) Exterior Insulation* and DuPont™ Thermax™ (ci) Exterior Insulation*, and maximum of 90 days for DuPont™ Thermax™ Sheathing*.

END OF SECTION



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DuPont™ Styrofoam™ Brand Spray Polyurethane Foam* contains isocyanate, hydrofluorocarbon blowing agent and polyol. Read the instructions and (Material) Safety Data Sheet ((M)SDS) carefully before use. Wear protective clothing (including long sleeves), gloves, goggles and proper respiratory protection. Supplied air or an approved air-purifying respirator equipped with an organic vapor sorbent and a P100 particulate filter is required to maintain exposure levels below ACGIH, OSHA, WEEL or other applicable limits. Provide adequate ventilation. Contents under pressure. Styrofoam™ Brand SPF should be installed by a trained SPF applicator.

CAUTION: When cured, these products are combustible and will burn if exposed to open flame or sparks from high-energy sources. Do not expose to temperatures above 240°F (116°C). For more information, consult (Material) Safety Data Sheet ((M)SDS), call DuPont at 1-866-583-2583 or contact your local building inspector. In an emergency, call 1-989-636-4400 in the U.S. or 1-519-339-3711 in Canada.

DuPont™ Great Stuff Pro™ Polyurethane Foam Sealants and Adhesives* contain isocyanate and a flammable blowing agent. Read all instructions and (Material) Safety Data Sheet ((M)SDS), carefully before use. Eliminate all sources of ignition before use. Cover all skin. Wear long sleeves, gloves, and safety glasses or goggles. Not for use in aviation, or food/beverage contact, or as structural support in marine applications. Provide adequate ventilation or wear proper respiratory protection. Contents under pressure. Not to be used for filling closed cavities or voids such as behind walls and under tub surrounds.

CAUTION: When cured, these products are combustible and will burn if exposed to open flame or sparks from high-energy sources. Do not expose to temperatures above 240°F (116°C). For more information, consult (Material) Safety Data Sheet ((M)SDS), call DuPont at 1-866-583-2583 or contact your local building inspector. In an emergency, call 1-989-636-4400 in the U.S. or 1-519-339-3711 in Canada.

DuPont Polyurethane Foam Insulation and Sealant*

CAUTION: When cured, these products are combustible and will burn if exposed to open flame or sparks from high-energy sources. Do not expose to temperatures above 240°F (116°C). For more information, consult (Material) Safety Data Sheet ((M)SDS), call DuPont at 1-866-583-2583 or contact your local building inspector. In an emergency, call 1-989-636-4400 in the U.S. or 1-519-339-3711 in Canada.

CAUTION: This product is combustible and shall only be used as specified by the local



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building code with respect to flame spread classification and to the use of a suitable thermal barrier. For more information, consult (Material) Safety Data Sheet ((M)SDS), call DuPont at 1-866-583-2583 or contact your local building inspector. In an emergency, call 1-989-636-4400 in the U.S. or 1-519-339-3711 in Canada.

DuPont™ LiquidArmor™ Flashing and Sealant*

Read the instructions and (Material) Safety Data Sheets ((M)SDS) carefully before use. It is recommended that spray applicators and those working in the spray area wear eye protection. Contact with exposed skin may cause skin discoloration and dryness. Gloves are recommended for prolonged exposures. Ensure adequate ventilation during spray applications.

DuPont™ Thermax™ Brand Polyisocyanurate Insulation*

CAUTION: This product is combustible and shall only be used as specified by the local building code with respect to flame spread classification and to the use of a suitable thermal barrier. For more information, consult (Material) Safety Data Sheet ((M)SDS), call DuPont at 1-866-583-2583, or contact your local building inspector. In an emergency, call 1-989-636-4400.

DuPont™ Styrofoam™ Extruded Polystyrene Foam Insulation*

CAUTION: This product is combustible. Protect from high heat sources. A protective barrier or thermal barrier may be required as specified in the appropriate building code. For more information, consult (Material) Safety Data Sheet ((M)SDS), call DuPont at 1-866-583-2583 or contact your local building inspector. In an emergency, call 1-989-636-4400 in the U.S. or 1-519-339-3711 in Canada.

WARNING: Rigid foam insulation does not constitute a working walkable surface or qualify as a fall protection product.

Building and/or construction practices unrelated to building materials could greatly affect moisture and the potential for mold formation. No material supplier including DuPont can give assurance that mold will not develop in any specific system.

*A former product of The Dow Chemical Company

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Form No. 43-D100413-enNA-0521

SECTION 072110 - THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Extruded polystyrene foam-plastic board used for the following applications:
 - a. Thermal breaks at exterior curbs and slabs at perimeter of building.
 - b. Concealed building insulation not specified as part of specification sections for Unit Masonry and Metal Wall and Roof Panel assemblies.
 - 2. Mineral-wool blanket insulation used as a thermal barrier at the following applications:
 - a. Framed wall assemblies where shown on the drawings.
 - b. Filing miscellaneous voids where shown on the drawings.
 - 3. Closed Cell Foam insulation board used for the following applications:
 - a. Under concrete interior and exterior slabs.
- B. Related Requirements:
 - 1. Section 042000 "Unit Masonry" for insulation installed in masonry cells.
 - 2. Section 075419 "Polyvinyl-Chloride (PVC) Roofing" for insulation specified as part of roofing construction.
 - 3. Section 092900 "Gypsum Board" for sound attenuation blanket used as acoustic insulation.

1.2 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD

- A. Extruded polystyrene boards in this article are also called "XPS boards."
- B. Extruded Polystyrene Board, for below grad applications: ASTM C 578, Type IV, 25-psi (173-kPa) minimum compressive strength; unfaced; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. DiversiFoam Products.
 - b. Dow Chemical Company (The)
 - c. Owens Corning.
 - 2. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
 - 3. Thickness as indicated on drawings.
 - 4. Provide 40-psi (276 - kPa) compressive strength board at all horizontal applications.
- C. Extruded Polystyrene Board for above grade, concealed building insulation use: ASTM C 578-, Type IV, 25 psi minimum compressive strength, unfaced, R5.6 per inch. Provide thickness as indicated on the drawings.
 - 1. Basis-of-Design: Styrofoam Cavitymate Ultra Extruded Polystyrene Foam Insulation as manufactured by The Dow Chemical Company.
 - 2. Equal products as manufactured by one of the following companies are also acceptable:
 - a. DiversiFoam Products.
 - b. Owens Corning.

- D. Adhesive and Joint Filler: Type as recommended and approved by the insulation manufacturer.

2.2 MINERAL-WOOL BLANKETS

- A. Mineral-Wool Blanket, Unfaced: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

2.3 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD

- A. Closed Cell Foam Insulation Board, for below grade applications: ASTM C 578, Type VII, 25-psi (173-kPa) minimum compressive strength; unfaced; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84.
 - 1. Basis-of-Design: Dupont Styrofoam Brand Highload 60 insulation as manufactured by The DuPont Company.
 - 2. Equal products as manufactured by one of the following companies are also acceptable:
 - a. DiversiFoam Products.
 - b. DuPont Company (The)
 - c. Owens Corning.
 - 3. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
 - 4. Water Vapor Permeance of .8 perm per ASTM E96.
 - 5. Thickness as indicated on drawings.
 - 6. Provide 60-psi compressive strength board at all horizontal applications.
- B. Adhesive and Joint Filler: Type as recommended and approved by the insulation manufacturer.

ACCESORIES

- A. Insulation for Miscellaneous Voids:
 - 1. Mineral Wool Insulation: Unfaced: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
 - 2. Spray Polyurethane Foam Insulation: ASTM C 1029, Type II, closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.
- B. Insulation Anchors, Spindles, and Standoffs: As recommended by manufacturer.
- C. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.

- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.2 INSTALLATION OF BELOW-GRADE INSULATION

- A. On vertical surfaces, set insulation units using manufacturer's recommended adhesive according to manufacturer's written instructions.
 - 1. If not otherwise indicated, extend insulation a minimum of 48 inches below exterior grade line.
- B. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

3.3 INSTALLATION OF INSULATION IN CONCEALED BUILDING AREAS

- A. Extruded Polystyrene Board Insulation: Install pads of adhesive spaced approximately 24 inches (610 mm) o.c. both ways on inside face and as recommended by manufacturer. Fit courses of insulation between wall framing and other obstructions, with edges butted tightly in both directions. Press units firmly against inside substrates.
- B. Seal all joints, gaps and voids with joint filler.

3.4 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

- A. Blanket installation: Install in cavities formed by framing members according to the following requirements:
 - 1. Use installation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
 - 2. Place installation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
- B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:
 - 1. Mineral-wool Insulation, where indicated on Drawings.
 - 2. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions, where indicated on Drawings.

3.5 PROTECTION

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 072100

SECTION 072119 - FOAMED-IN-PLACE INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Closed-cell spray polyurethane foam insulation.
2. Open-cell spray polyurethane foam insulation.
3. Accessories.

B. Related Requirements:

1. Section 061600 "Sheathing" for polyisocyanurate-foam exterior sheathing.
2. Section 072100 "Thermal Insulation" for foam-plastic board insulation.

1.2 REFERENCES

A. Abbreviations and Acronyms:

1. CPI: Center for the Polyurethane Industry.
2. SPF: Spray-polyurethane foam.
3. SPFA: Spray Polyurethane Foam Alliance.
4. UES/IAMPO: Uniform Evaluation Service and International Association of Plumbing and Mechanical Officials.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Closed-cell spray polyurethane foam insulation.
2. Open-cell spray polyurethane foam insulation.
3. Accessories.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each product, for tests performed by qualified testing agency.
- B. Field quality-control reports.
- C. Qualification Statements: For Installer.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized applicator who is trained and approved by SFI manufacturer.

PART 2 - PRODUCTS

2.1 CLOSED-CELL SPRAY POLYURETHANE FOAM INSULATION

- A. Closed-Cell Spray Polyurethane Foam: ASTM C1029, Type II, minimum density of 1.5 lb/cu. ft. (24 kg/cu. m) and minimum aged R-value at 1-inch (25.4-mm) thickness of 6.2 deg F x h x sq. ft./Btu at 75 deg F (43 K x sq. m/W at 24 deg C).
1. Basis-of-Design Product: Subject to compliance with requirements, provide Carlisle Spray Foam Insulation; SealTite PRO Closed Cell or a comparable product by one of the following:
 - a. Gaco; a brand of Firestone Building Products.
 - b. Henry Company.
 - c. Substitutions: See Section 012500
 2. Surface-Burning Characteristics: Report surface-burning characteristics in accordance with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 450 or less.
 3. Fire Propagation Characteristics:
 - a. Passes NFPA 285 testing as part of an approved assembly.
 - b. Passes NFPA 286 testing when covered with intumescent coating approved by SPF insulation manufacturer or product as listed in UES/IAMPO report.
 4. Fire Resistance Ratings: Passes ASTM E119 testing as part of an approved assembly.
 5. Compressive Strength: Minimum 30 psi (206 kPa) in accordance with ASTM D1621.
 6. Air Permeance per 1 Inch (25.4 mm): Minimum 0.004 cfm/sq. ft. at 1.57 lbf/sq. ft. (0.02 L/s x sq. m at 75 Pa) in accordance with ASTM E2178 and ASTM E2357.
 7. Water Vapor Permeance: 1.0 perm or less at 1 inch (57 ng/Pa x s. x sq. m or less at 25.4 mm) in accordance with ASTM E96 desiccant method.
 8. Dimensional Stability: Less than 9 percent change in volume in accordance with ASTM D2126.
 9. Compliance with State Environmental Regulations:
 - a. Global Warming Potential: Two or less.
 - b. Ozone Depletion Potential: Zero.

10. Toxicity and Hazardous Materials:

- a. UL Greenguard Certification for low-chemical emissions in accordance with UL 2818: Greenguard Gold.
- b. Product containing no added urea-formaldehyde.
- c. PBDE-free product.
- d. Free of flammable blowing agents.
- e. Free of trans-1,2-Dichloroethene, TDCE, 1,2-Dichloroethene, 1,2-DCE, and trans-dichloroethylene.

2.2 ACCESSORIES

- A. Primer: Material recommended by insulation manufacturer where required for adhesion of insulation to substrates.
- B. Thermal Barrier: Material barrier intended to prevent flame-source access to foam and delay temperature-rise of foam during a fire event.
 1. Thermal Barrier Coating: Fire-protective intumescent coating formulated for application over polyurethane foam plastics, compatible with insulation, and passes NFPA 286 or UL 1715 testing as part of an approved assembly.
 - a. Basis-of-Design Product: Subject to compliance with requirements, provide International Fireproof Technology Inc.; DC315 Thermal and Ignition Barrier or comparable product by one of the following:
 - 1) Flame Control Coatings, LLC.
 - 2) No-Burn, Inc.
 - 3) TPR2 Corporation.
 2. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 50 or less.
- C. Ignition Barrier: Material providing a 15-minute minimum fire-ignition barrier.
 1. Ignition Barrier Coating: Fire-protective coating formulated for application over polyurethane foam plastics, compatible with insulation, and in compliance with ICC-ES AC377, Appendix X.
 - a. Basis-of-Design Product: Subject to compliance with requirements, provide International Fireproof Technology Inc; DC315 Thermal and Ignition Barrier or comparable product by one of the following:
 - 1) Flame Control Coatings, LLC.
 - 2) No-Burn, Inc.
 - 3) TPR2 Corporation.

2. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 50 or less.

- D. Liquid-Applied Vapor Retarder Coating: Water vapor retarder coating formulated for application over open-cell polyurethane foam plastics, with a maximum vapor permeance of 1.0 perm (55 ng/Pa x s sq. m) when tested on compatible open-cell polyurethane foam plastic substrates in accordance with ASTM E96 as documented by spray foam product Evaluation Report.
 1. Basis-of-Design Product: Subject to compliance with requirements, provide Carlisle Spray Foam Insulation; SealTite PRO VRC-2 or comparable product.
 2. Performance Criteria:
 - a. VOC Content: 50 g/L or less.
 - b. Solids by Volume: 53 percent.
 - c. Solids by Weight: 52 percent.
 - d. Viscosity: Greater than 18,000 and less than 22,000 centipoise (CPS) at 70 deg°F (21 deg C).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that substrates are clean, dry, and free of dust, debris, oil, solvents, and other materials that may adversely affect SPF adhesion.

3.2 PREPARATION

- A. Do not begin installation until substrates have been properly prepared.
- B. Clean surfaces thoroughly prior to installation.
- C. Mask and protect adjacent surfaces from fugitive overspray.
- D. Establish measures to protect non-SPF trade workers and building occupants.
 1. Non-SPF trade workers are recommended to vacate building during SPF installation.
 2. For large structures, all non-SPF workers and occupants will vacate building unless SPF Installer establishes enclosures to isolate Work area. For SPF enclosure assistance, see CPI Spray Foam Coalition's "Guidance of Ventilation during Installation of Interior Applications of High-Pressure Spray Polyurethane Foam."
 3. Properly ventilate SPF work areas.

4. Continue ventilation for 24 hours after interior application of SPF insulation, with a minimum outdoor air exchange rate of one air change per hour.
5. Recommended re-entry times after completion of SPF insulation installation are as follows:
 - a. Non-SPF Trade Workers: 12 hours.
 - b. All Others: One-hour reentry with minimum 20 ACH.
- E. Prepare surfaces using SPF manufacturer's written instructions for achieving best result for substrate under Project conditions. Surfaces will be clean, dry, and firmly anchored.
- F. Priming: Prime substrates where recommended by insulation manufacturer. Apply primer to comply with insulation manufacturer's written instructions. Confine primers to areas to be insulated; do not allow spillage or migration onto adjoining surfaces.

3.3 INSTALLATION

- A. Comply with insulation manufacturer's written instructions applicable to products and applications, as found on drum labels, product data sheets, and application guidelines. Spray insulation to envelop entire area to be insulated and fill voids.
- B. Apply in multiple passes to not exceed maximum thicknesses recommended by manufacturer. Do not spray into rising foam.
- C. Framed Construction: Install into cavities formed by framing members to achieve thickness indicated on Drawings.
- D. Cavity Walls: Install into cavities to [thickness indicated on Drawings] [fully fill void].
- E. Miscellaneous Voids: Apply in accordance with manufacturer's written instructions.
- F. Install [thermal] [ignition] [vapor retarder] barrier material.
 1. Do not cover insulation prior to any required spray foam insulation inspections.
- G. Apply barrier coatings in accordance with manufacturer's written instructions and to comply with requirements for listing and labeling for fire-propagation characteristics and surface-burning characteristics specified.
 1. Use equipment and techniques best suited for substrate and type of material applied as recommended by coating manufacturer.
 2. Apply coatings to prepared surfaces as soon as practical after preparation and before subsequent surface soiling or deterioration.
 3. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Produce sharp lines and color breaks.
- H. Ventilate enclosed spray areas during installation and for 24 hours after spray application has ended.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect spray foam insulation installation, including accessories. Report results in writing.

3.5 PROTECTION

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes.

END OF SECTION 072119

SECTION 072713 - MODIFIED BITUMINOUS SHEET AIR BARRIERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Self-adhering, vapor-retarding, modified bituminous sheet air barriers used where Metal Siding Panels are applied over wall sheathing and at flashing locations.

1.2 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General: Air barrier shall be capable of performing as a continuous vapor-retarding air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

2.2 SELF-ADHERING SHEET AIR BARRIER

- A. Modified Bituminous Sheet: 18-mil composite impermeable membrane that is comprised of 12 mils of butyl and 6 mils of HDPP facer.
 - 1. Products: Subject to compliance with requirements, provide TREMCO; "ExoAir 110AT" or equal products as manufactured by one of the following manufacturers:
 - a. Carlisle Coatings & Waterproofing Inc.
 - b. Meadow, W.R., Inc.
 - c. GCP Applied Technologies, Inc.
 - 2. Physical and Performance Properties:
 - a. Air Permeance: Maximum 0.001 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. (0.02 L/s x sq. m of surface area at 75-Pa) pressure difference; ASTM E 2178.
 - b. Tensile Strength: Minimum 400 psi (2.8 MPa); ASTM D 412, Die C.
 - c. Ultimate Elongation: Minimum 200 percent; ASTM D 412, Die C.
 - d. Puncture Resistance: Minimum 40 lbf (180 N); ASTM E 154.
 - e. Water Absorption: Maximum 0.10 percent weight gain after 48-hour immersion at 70 deg F (21 deg C); ASTM D 570.
 - f. Vapor Permeance: Maximum 0.05 perm (2.9 ng/Pa x s x sq. m); ASTM E 96/E 96M, Water Method.

2.3 ACCESSORY MATERIALS

- A. General: Accessory materials recommended by air-barrier manufacturer to produce a complete air-barrier assembly and compatible with primary air-barrier membrane.
- B. Primer: Liquid waterborne primer recommended for substrate by air-barrier material manufacturer.
- C. Termination Mastic: Air-barrier manufacturer's standard cold fluid-applied elastomeric liquid; trowel grade.

- D. Sealant: One part neutral curing, ultra-low modulus silicone sealant for sealing penetrations and terminations.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION

- A. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.
- B. Prepare, fill, prime, and treat joints and cracks in substrates. Remove dust and dirt from joints and cracks according to ASTM D 4258.
- C. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.

3.2 INSTALLATION

- A. General: Install modified bituminous sheets and accessory materials according to air-barrier manufacturer's written instructions and according to recommendations in ASTM D 6135.
 - 1. When ambient and substrate temperatures range between 25 and 40 deg F (minus 4 and plus 5 deg C), install self-adhering, modified bituminous air-barrier sheet produced for low-temperature application. Do not install low-temperature sheet if ambient or substrate temperature is higher than 60 deg F (16 deg C).
- B. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by air-barrier sheet on same day. Reprime areas exposed for more than 24 hours.
- C. Apply and firmly adhere modified bituminous sheets horizontally over area to receive air barrier. Accurately align sheets and maintain uniform 2-1/2-inch- (64-mm-) minimum lap widths and end laps. Overlap and seal seams, and stagger end laps to ensure airtight installation.
 - 1. Apply sheets in a shingled manner to shed water without interception by any exposed sheet edges.
 - 2. Roll sheets firmly to enhance adhesion to substrate.
- D. Seal top of through-wall flashings to air-barrier sheet.
- E. Seal exposed edges of sheet at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.
- F. Install air-barrier sheet and accessory materials to form a seal with adjacent construction and to maintain a continuous air barrier.
- G. Fill gaps in miscellaneous penetrations of air-barrier membrane with sealant.
- H. At end of each working day, seal top edge of air-barrier material to substrate with termination mastic.
- I. Repair punctures, voids, and deficient lapped seams in air barrier. Slit and flatten fishmouths and blisters. Patch with air-barrier sheet extending 6 inches (150 mm) beyond repaired areas in all directions.
- J. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

3.3 FIELD QUALITY CONTROL

- A. Protect air-barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.
 - 1. Protect air barrier from exposure to UV light and harmful weather exposure as required by manufacturer. If exposed to these conditions for more than 60 days, remove and replace air barrier or install additional, full-thickness, air-barrier

- application after repairing and preparing the overexposed membrane according to air-barrier manufacturer's written instructions.
2. Protect air barrier from contact with incompatible materials and sealants not approved by air-barrier manufacturer.

END OF SECTION 072713

SECTION 074113 - STANDING-SEAM METAL ROOF PANELS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Standing-seam metal roof panels.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
1. Meet with Owner, Architect, Owner's insurer if applicable, metal panel Installer, metal panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal panels, including installers of roof accessories and roof-mounted equipment.
 2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 3. Review methods and procedures related to metal panel installation, including manufacturer's written instructions.
 4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
 5. Review structural loading limitations of deck during and after roofing.
 6. Review flashings, special details, drainage, penetrations, equipment curbs, and condition of other construction that affect metal panels.
 7. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
 8. Review temporary protection requirements for metal panel systems during and after installation.
 9. Review procedures for repair of metal panels damaged after installation.
 10. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.3 ACTION SUBMITTALS

- A. Product Data: For standing-seam metal roof panels. 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 (1:10).
 - 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 (305 mm) 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 standing-seam metal roof panels, for tests performed by a qualified testing agency.
 - C. Field quality-control reports.
 - D. 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.
- 1.7 MOCKUPS
- A. 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 area and eave, including fascia, and soffit as shown on Drawings; approximately 12 feet (3.5 m) square by full thickness, including attachments, underlayment, 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. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 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.
- E. Copper Panels: Wear gloves when handling to prevent fingerprints and soiling of surface.

1.9 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.

1.10 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.

1.11 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.
 3. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 STANDING-SEAM METAL ROOF PANELS

- A. 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 in side laps. Include clips, cleats, pressure plates, and accessories required for weathertight installation.
- B. Vertical-Rib, Snap-Joint, Standing-Seam Metal Roof Panels: Formed with vertical ribs at panel edges and intermediate stiffening ribs symmetrically spaced between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels, engaging opposite edge of adjacent panels, and snapping panels together.
 1. Copper Sheet: ASTM B370, cold-rolled copper sheet, H00 temper.
 - a. Thickness: 20 oz./sq. ft. (0.68 mm thick).
 - b. Exposed Finish: Prepatinated.
 - c. Prepatinated Color: Verdigris.
 2. Clips: Two-piece floating to accommodate thermal movement.
 - a. 0.0625-inch- (1.587-mm-) thick, stainless steel sheet.
 3. Panel Coverage: 24 inches (610 mm).
 4. Panel Height: 1.5 inches (38 mm).

2.2 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Sheet: Minimum 30 mils (0.76 mm) thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer according to written recommendations of underlayment manufacturer.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Carlisle Coatings & Waterproofing Inc.
 - b. Carlisle Residential; a division of Carlisle Construction Materials.
 - c. Grace Construction Products; W.R. Grace & Co. -- Conn.
 - d. Henry Company.
 - e. Substitutions: See Section 012500 - Substitution Procedures.

2. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F (116 deg C) or higher.
3. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F (29 deg C) or lower.

2.3 MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Subframing and Furring: ASTM C645; cold-formed, metallic-coated steel sheet, ASTM A653/A653M, G90 (Z275) hot-dip galvanized coating designation or ASTM A792/A792M, Class AZ50 (Class AZM150) 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- (25-mm-) 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- (2400-mm-) long sections, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual." Furnish gutter supports spaced a maximum of 36 inches (914 mm) o.c., fabricated from same metal as gutters. Provide wire ball strainers of compatible metal at outlets. Finish gutters to match roof fascia and rake trim.
- E. Downspouts: Formed from same material as roof panels. Fabricate in 10-foot- (3-m-) 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 (1.2-mm) nominal thickness; with bottom of skirt profiled to match roof panel profiles and with welded top box and integral full-length cricket. Fabricate curb subframing of 0.060-inch- (1.52-mm-) nominal thickness, angle-, C-, or Z-shaped steel sheet. Fabricate

curb and subframing to withstand indicated loads of size and height indicated. Finish roof curbs to match metal roof panels.

1. Insulate roof curb with 1-inch- (25-mm-) 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 nonstaining, 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, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.
 2. Joint Sealant: ASTM C920; 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 C1311.

2.4 FABRICATION

- A. 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 nonexpansion, 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. 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.
- B. Copper Panels and Accessories:
 1. Prepatination: Factory prepatinate according to ASTM B882 to convert the copper surface to an inorganic crystalline structure with the appearance and durability of naturally formed patina.

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 subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C754 and metal panel manufacturer's written recommendations.

3.3 INSTALLATION OF UNDERLAYMENT

- 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 (152 mm) staggered 24 inches (610 mm) between courses. Overlap side edges not less than 3-1/2 inches (90 mm). Extend underlayment into gutter trough. Roll laps with roller. Cover underlayment within 14 days.
 - 1. Apply over the entire roof surface.
- B. Felt Underlayment: Apply at locations indicated below, in shingle fashion to shed water, and with lapped joints of not less than 2 inches (50 mm).
 - 1. Apply over the entire roof surface.
- C. Flashings: Install flashings to cover underlayment to comply with requirements specified in Section 076200 "Sheet Metal Flashing and Trim."

3.4 INSTALLATION OF STANDING-SEAM METAL ROOF PANELS

- A. 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. Copper Panels: Use copper, stainless steel, or hardware-bronze fasteners.
- C. Anchor Clips: Anchor metal roof panels and other components of the Work securely in place, using manufacturer's approved fasteners according to manufacturers' written instructions.
- D. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.
- E. 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. 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 (152-mm) 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, 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.
- 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 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 (3 m) with no joints allowed within 24 inches (610 mm) 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 (25 mm) deep, filled with mastic sealant (concealed within joints).

- H. Gutters: Join sections with riveted and soldered or lapped and sealed joints. Attach gutters to eave with gutter hangers spaced not more than 36 inches (914 mm) o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.

- I. Downspouts: Join sections with telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch (25 mm) away from walls; locate fasteners at top and bottom and at approximately 60 inches (1524 mm) 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.

- J. Roof Curbs: Install flashing around bases where they meet metal roof panels.

- K. 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 (6 mm in 6 m) on slope and location lines as indicated and within 1/8-inch (3-mm) 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 074113

SECTION 074213 - METAL PLATE WALL PANELS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes aluminum metal plate wall panels.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site to review and finalize schedule, verify availability of materials and personnel, review means and methods of installation, examine support conditions, and review flashings, special details, penetrations, and other conditions that affect Work. Conference shall include the representatives from the following:

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 metal plate wall panel and accessory.
- B. Shop Drawings: Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment assembly, trim, flashings, closures, and accessories; and special details.
- C. Coordination Drawings: Submit exterior elevations, drawn to scale, that have the following items shown and coordinated with each other, using input from installers of the following items:
 - 1. Metal plate wall panels and attachments.
 - 2. Girts.
 - 3. Wall-mounted items including doors, windows, louvers, and lighting fixtures.
 - 4. Penetrations of wall by pipes and utilities.
- D. Samples: For each type of metal panel indicated.
 - 1. Aluminum Metal Plate Wall Panels: At least 2 inch by 3 inch.

1.4 INFORMATIONAL SUBMITTALS

- A. Product test reports.
- B. Warranties: Samples of special warranties.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
 - 1. Install system in strict compliance with manufacturer's installation instructions.
- B. Source Limitations: Obtain each type of metal plate wall panel from single source and from single manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
- B. Storage and Handling: Store materials in clean, dry, interior area in accordance with manufacturer's instructions.
- C. Deliver panels, components, and other manufactured items without damage or deformation.
- D. Protect panels during transportation, handling, and installation from weather, excessive temperatures and construction operations.
- E. Handle panels in strict compliance with manufacturer's instructions and recommendations, and in a manner to prevent bending, warping, twisting, and surface damage.
 - 1. Store panels vertically with top of panel down, storage of panels horizontally is not permitted.
- F. Store panels covered with suitable weather tight and ventilated covering.
- G. Provide storage of panels to ensure dryness, with positive slope for drainage of moisture.
- H. Do not store panels in contact with other materials that might cause staining, denting, or other surface damage.
- I. Remove strippable protective covering from aluminum panel prior to installation.

1.8 SITE CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of this Work to be performed according to manufacturer's installation instructions and warranty requirements.
- B. Field Measurements: Verify locations of structural members and wall opening dimensions by field measurements before panel fabrication and indicate measurements on Shop Drawings.
 - 1. Coordinate with construction schedule.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 330:
 - 1. Wind Loads: As indicated on Drawings.
 - 2. Other Design Loads: As indicated on Drawings.

3. Deflection Limits: For wind loads, no greater than 1/180 of the span.
- B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m) when tested according to ASTM E 283 at the following test-pressure difference:
 1. Test-Pressure Difference: 1.57 lbf/sq. ft. (75 Pa).
- 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: 2.86 lbf/sq. ft. (137 Pa).
- 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 (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
- E. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.2 METAL PLATE WALL PANELS

- A. General: Provide metal panels designed to be field assembled by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using stainless steel fasteners. Include accessories required for weathertight installation.
- B. Flat plate, Open Joint Exposed-Fastener Metal Wall Panels (**MP-1**): Formed with vertical panel edges and a flat pan between panel edges; with open joint between panels.
 1. Basis-of-Design: , 1/4" plate steel Wall panels.
 - a. Subject to meeting the specified requirements, formed metal wall panels by the following manufacturers are also acceptable:
 - 1) IRONBOUND WEATHERING STEEL
 - 2) Substitutions: See Section 012500 - Product Requirements
 2. Weathering Steel Sheet
 - a. Nominal Thickness: 18-gage (0.91 mm).
 - b. Surface: Smooth.
 - c. Panel Coverage: VARIES.
 - d. Exterior Finish: Weathering Steel.

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 (Z275 hot-dip galvanized) coating designation or ASTM A 792/A 792M, Class AZ50 (Class AZM150) aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.
- B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, 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.
- C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance.

Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.

- D. Panel Fasteners: Designed to withstand design loads, with at least 7/16 inch diameter head and neoprene washer.
 - 1. Aluminum Wall Panel Material: Provide stainless steel fasteners, or coated fastener approved by panel manufacturer.
- E. Panel Sealants: ASTM C 920; as recommended in writing by metal panel manufacturer.

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. 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.

2.5 FINISHES

- A. Aluminum Panels and Accessories:
 - 1. 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.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, and Work areas and conditions with Installer present for compliance with requirements for installation tolerances, wall panel supports, and other conditions affecting performance of this Work.
- B. Examine wall framing to verify that girts, angles, channels, studs, and other structural wall panel support members and anchorage have been installed within alignment tolerances required by wall panel manufacturer.
- C. Verify that weather barrier has been installed over sheathing or substrate to prevent air infiltration or water penetration.
- D. Examine rough-in for components and systems penetrating wall panels to coordinate actual penetration locations relative to wall panel joint locations prior to installation.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal panel manufacturer's written recommendations.

3.3 INSTALLATION

- A. Install wall panels in accordance with manufacturer's installation instructions, including pressure equalized rainscreen installation method and installation guidelines.
 - 1. Wall panels consist of single sheets of metal formed with interlocking gutter and drainage system integral to the panel with single horizontal attachment for dry-joint rainscreen assembly.
 - 2. Use of secondary drainage channels, brackets, support pins, joint sealants or gaskets to manage the drainage of wall panel system is not permitted.
 - 3. Attach wall panels using progressive interlocking method, engaging bottom of panel in top of previous panel working bottom up, and left to right.
 - 4. Install wall panels with single top attachment in pre-punched holes to allow individual panels to move due to thermal expansion.
 - 5. Do not compromise internal gutter.
- B. Install wall panels for orientation, sizes, and locations as indicated on Drawings.
- C. Install wall panels with proper anchorage and other components for this Work securely in place.
- D. Install wall panels with provisions for thermal and structural movement.
- E. Install shims to plumb substrates as necessary for installation of wall panels.
- F. Install weather tight seals at perimeter of wall panel openings.
 - 1. Test for proper adhesion on small unexposed area of solid surfacing prior to use.
- G. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA - Architectural Sheet Metal Manual.
 - 1. Provide concealed fasteners where possible, and set units true to line and level as indicated.
 - 2. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
 - 3. Install flashing and trim as wall panel Work proceeds.
- H. Install weather tight escutcheons for pipe and conduit penetrating exterior walls.
- I. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action as recommended by wall panel manufacturer.
- J. Install attachment system to support wall panels and with provisions to provide a complete weather tight wall system, including sub girts, extrusions, flashings and trim.
 - 1. Include attachment to supports and trims at locations using dissimilar materials.
 - 2. Do not apply sealants to joints, unless noted otherwise on Drawings or Shop Drawings.
 - 3. Install starter extrusion at base course and at cut panel locations.
- K. Install accessories with positive anchorage to building and weather tight mounting and provisions for thermal expansion, and coordinate installation with flashings and other components.
- L. Weather Barrier: Install weather barrier behind wall panels and over substrate in accordance with requirements of Section 07 2500.

3.4 TOLERANCES

- A. Shim and align wall panel units with installed tolerances of 1/4 inch in 20 feet, non-cumulative, on level, plumb, and location lines as indicated.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing agency to perform field tests and inspections.
- B. Water-Spray Test: After installation and in coordination with Mockup requirements, test area of assembly as directed by Architect for water penetration in accordance with AAMA 501.2.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect completed metal wall panel installation, including accessories.
- D. Remove and replace metal wall panels where tests and inspections indicate that they do not comply with specified requirements.
- E. Perform additional tests and inspections, at Contractor's expense, to verify compliance of replaced wall panels or necessary additional work with specified requirements.
- F. Prepare test and inspection reports.

3.6 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. Protect installed products from damage during subsequent construction.
- C. Replace wall panels damaged or deteriorated beyond successful repair by finish touchup or similar minor repair procedures

END OF SECTION 074213

SECTION 075419 - POLYVINYL-CHLORIDE (PVC) ROOFING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Mechanically fastened, polyvinyl chloride (PVC) roofing system.
 - 2. Roof insulation.
 - 3. Walkways.

1.2 PREINSTALLATION MEETINGS

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

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. For insulation and roof system component fasteners, include copy of FM Approvals' RoofNav listing.
- B. Shop Drawings: Include roof plans, sections, details, and attachments to other work, including the following:
 - 1. Layout and thickness of insulation.
 - 2. Base flashings and membrane terminations.
 - 3. Flashing details at penetrations.
 - 4. Tapered insulation thickness and slopes.
 - 5. Roof plan showing orientation of steel roof deck and orientation of roof membrane, fastening spacings, and patterns for mechanically fastened roofing system.
 - 6. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
 - 7. Tie-in with air barrier.
- C. Samples: For the following products:
 - 1. Roof membrane and flashing, of color required.
 - 2. Walkway pads or rolls, of color required.
- D. Wind Uplift Resistance Submittal: For roofing system, indicating compliance with wind uplift performance requirements.

1.4 INFORMATIONAL SUBMITTALS

- A. Manufacturer Certificates:
 - 1. Performance Requirement Certificate: Signed by roof membrane manufacturer, certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
 - a. Submit evidence of compliance with performance requirements.
 - 2. Special Warranty Certificate: Signed by roof membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.
- B. Product Test Reports: For roof membrane and insulation, tests performed by independent qualified testing agency indicating compliance with specified requirements.
- C. Research reports.

- D. Field Test Reports:
 - 1. Concrete internal relative humidity test reports.
 - 2. Fastener-pullout test results and manufacturer's revised requirements for fastener patterns.
- E. Field quality-control reports.
- F. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance data.
- B. Certified statement from existing roof membrane manufacturer stating that existing roof warranty has not been affected by Work performed under this Section.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: 20 years from date of Substantial Completion.
- B. Special Project Warranty: Submit roofing Installer's warranty, on warranty form at end of this section, signed by installer, covering Work of this Sections, including all components of roofing system such as roofing pavers, and walkway products, for the following warranty period.
 - 1. Warranty period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Accelerated Weathering: Roof membrane shall withstand 2000 hours of exposure when tested according to ASTM G 152, ASTM G 154, or ASTM G 155.
- B. Impact Resistance: Roof membrane shall resist impact damage when tested according to ASTM D 3746, ASTM D 4272/D 4272M, or the "Resistance to Foot Traffic Test" in FM Approvals 4470.
- C. Material Compatibility: Roofing materials shall be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roof membrane manufacturer based on testing and field experience.
- D. FM Approvals' RoofNav Listing: Roof membrane, base flashings, and component materials shall comply with requirements in FM Approvals 4450 or FM Approvals 4470 as part of a roofing system, and shall be listed in FM Approvals' RoofNav for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals Certification markings.
- E. Solar Reflectance Index: Not less than 78 when calculated according to ASTM E 1980, based on testing identical products by a qualified testing agency.
- F. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs indicated. Identify products with appropriate markings of applicable testing agency.

2.2 POLYVINYL CHLORIDE (PVC) ROOFING

- A. PVC Sheet: ASTM D 4434/D 4434M, Type III, fabric reinforced.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Carlisle SynTec Incorporated.
 - b. Duro-Last Roofing, Inc.
 - c. Flex Membrane International Corp.
 - d. GAF.
 - e. Johns Manville; a Berkshire Hathaway company.
 - f. Substitutions: See Section 012500 - Substitution Procedures.
 - 2. Membrane Thickness: 60 mils (1.5 mm).
 - 3. Exposed Face Color: White.

2.3 AUXILIARY ROOFING MATERIALS

- A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with other roofing components.
 - 1. Adhesives and sealants shall comply with the following limits for VOC content:
 - a. Plastic Foam Adhesives: 50 g/L.
 - b. Gypsum Board and Panel Adhesives: 50 g/L.
 - c. Multipurpose Construction Adhesives: 70 g/L.
 - d. Fiberglass Adhesives: 80 g/L.
 - e. Contact Adhesives: 80 g/L.
 - f. PVC Welding Compounds: 510 g/L.
 - g. Other Adhesives: 250 g/L.
 - h. Single-Ply Roof Membrane Sealants: 450 g/L.
 - i. Nonmembrane Roof Sealants: 300 g/L.
 - j. Sealant Primers for Nonporous Substrates: 250 g/L.
 - k. Sealant Primers for Porous Substrates: 775 g/L.
- B. Sheet Flashing: Manufacturer's standard sheet flashing of same material, type, reinforcement, thickness, and color as PVC sheet.
- C. Prefabricated Pipe Flashings: As recommended by roof membrane manufacturer.
- D. Water-Based, Fabric-Backed Membrane Adhesive: Roofing system manufacturer's standard water-based, cold-applied adhesive formulated for compatibility and use with fabric-backed membrane roofing.
- E. Metal Termination Bars: Manufacturer's standard, predrilled stainless steel or aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick; with anchors.
- F. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roofing components to substrate, and acceptable to roofing system manufacturer.
- G. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

2.4 ROOF INSULATION

- A. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 1, Grade 2, felt or glass-fiber mat facer on both major surfaces.
- B. Tapered Insulation: Provide factory-tapered insulation boards.
 - 1. Material: Match roof insulation.
 - 2. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

2.5 INSULATION ACCESSORIES

- A. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation and cover boards to substrate, and acceptable to roofing system manufacturer.
- B. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer as follows:
 - 1. Modified asphaltic, asbestos-free, cold-applied adhesive.
 - 2. Bead-applied, low-rise, one-component or multicomponent urethane adhesive.
 - 3. Full-spread, spray-applied, low-rise, two-component urethane adhesive.
 - 4. Adhesives and sealants shall comply with the following limits for VOC content:
 - a. Plastic Foam Adhesives: 50 g/L.
 - b. Gypsum Board and Panel Adhesives: 50 g/L.
 - c. Multipurpose Construction Adhesives: 70 g/L.
 - d. Fiberglass Adhesives: 80 g/L.
 - e. Contact Adhesives: 80 g/L.
 - f. PVC Welding Compounds: 510 g/L.
 - g. Other Adhesives: 250 g/L.
 - h. Single-Ply Roof Membrane Sealants: 450 g/L.
 - i. Nonmembrane Roof Sealants: 300 g/L.
 - j. Sealant Primers for Nonporous Substrates: 250 g/L.
 - k. Sealant Primers for Porous Substrates: 775 g/L.

2.6 WALKWAYS

- A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway rolls,
 - 1. Products: Subject to compliance, provide Plastex; Crossgrip PVC two layer walkway matting.
 - a. Height: 9/16 inch (14 mm) thick.
 - b. Width: 36 inches (914 mm).
 - c. Color: Light grey.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
 - 1. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Section 053100 "Steel Decking."

3.2 PREPARATION

- A. Perform fastener-pullout tests according to roof system manufacturer's written instructions.
 - 1. Submit test result within 24 hours of performing tests.
 - a. Include manufacturer's requirements for any revision to previously submitted fastener patterns required to achieve specified wind uplift requirements.

3.3 ROOFING INSTALLATION, GENERAL

- A. Install roofing system according to roofing system manufacturer's written instructions, FM Approvals' RoofNav assembly requirements, and FM Global Property Loss Prevention Data Sheet 1-29.
- B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at end of workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

3.4 INSULATION INSTALLATION

- A. Coordinate installing roofing system components, so insulation is not exposed to precipitation or left exposed at end of workday.
- B. Comply with roofing system and insulation manufacturer's written instructions for installing roof insulation.
- C. Installation Over Metal Decking:
 - 1. Install base layer of insulation with joints staggered not less than 24 inches (610 mm) in adjacent rows, end joints staggered not less than 12 inches (305 mm) in adjacent rows, and with long joints continuous at right angle to flutes of decking.
 - a. Locate end joints over crests of decking.
 - b. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.
 - c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
 - d. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
 - e. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches (610 mm).
 - 1) Trim insulation so that water flow is unrestricted.
 - f. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
 - g. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
 - h. Loosely lay base layer of insulation units over substrate.
 - i. Mechanically attach base layer of insulation using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to metal decks.
 - 1) Fasten insulation according to requirements in FM Approvals' RoofNav for specified Windstorm Resistance Classification.
 - 2) Fasten insulation to resist specified uplift pressure at corners, perimeter, and field of roof.
 - 2. Install upper layers of insulation and tapered insulation with joints of each layer offset not less than 12 inches (305 mm) from previous layer of insulation.
 - a. Staggered end joints within each layer not less than 24 inches (610 mm) in adjacent rows.
 - b. Install with long joints continuous and with end joints staggered not less than 12 inches (305 mm) in adjacent rows.
 - c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.

- d. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
- e. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches (610 mm).
- f. Trim insulation so that water flow is unrestricted.
- g. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
- h. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
- i. Loosely lay each layer of insulation units over substrate.
- j. Adhere each layer of insulation to substrate using adhesive according to FM Approvals' RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:
 - 1) Set each layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equi-viscous temperature.
 - 2) Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
 - 3) Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

3.5 MECHANICALLY FASTENED ROOFING INSTALLATION

- A. Mechanically fasten roof membrane over area to receive roofing according to roofing system manufacturer's written instructions.
- B. Unroll roof membrane and allow to relax before installing.
- C. For in-splice attachment, install roof membrane with long dimension perpendicular to steel roof deck flutes.
- D. Start installation of roofing in presence of roofing system manufacturer's technical personnel.
- E. Accurately align roof membrane and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
- F. Mechanically fasten or adhere roof membrane securely at terminations, penetrations, and perimeter of roofing.
- G. Apply roof membrane with side laps shingled with slope of roof deck where possible.
- H. In-Seam Attachment: Secure one edge of PVC sheet using fastening plates or metal battens centered within seam, and mechanically fasten PVC sheet to roof deck.
- I. Seams: Clean seam areas, overlap roof membrane, and hot-air weld side and end laps of roof membrane and sheet flashings to ensure a watertight seam installation.
 - 1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of roof membrane and sheet flashings.
 - 2. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.
 - 3. Repair tears, voids, and lapped seams in roof membrane that do not comply with requirements.
- J. Spread sealant bed over deck-drain flange at roof drains, and securely seal roof membrane in place with clamping ring.

3.6 BASE FLASHING INSTALLATION

- A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to roofing system manufacturer's written instructions.
- B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate and allow to partially dry. Do not apply to seam area of flashing.
- C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.
- D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.
- E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.7 WALKWAY INSTALLATION

- A. Flexible Walkways: Install walkway products according to manufacturer's written instructions.
 - 1. Install flexible walkways at the following locations:
 - a. Locations indicated on Drawings.

3.8 PROTECTING AND CLEANING

- A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing, inspect roofing system for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.
- B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.
- C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 075419

SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Formed low-slope roof sheet metal fabrications.
 - 2. Formed wall sheet metal fabrications.
 - 3. Self-adhering underlayment.

1.2 PREINSTALLATION MEETINGS

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

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For sheet metal flashing and trim.
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Distinguish between shop- and field-assembled work.
 - 3. Include identification of finish for each item.
 - 4. Include pattern of seams and details of termination points, expansion joints and expansion-joint covers, direction of expansion, roof-penetration flashing, and connections to adjoining work.
- C. Samples: For each exposed product and for each color and texture specified.

1.4 INFORMATIONAL SUBMITTALS

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

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance data.
- B. Special warranty.

1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.
 - 1. For copings and roof edge flashings that are SPRI ES-1 tested, shop shall be listed as able to fabricate required details as tested and approved.
- B. Mockups: Build mockups to verify selections made under Sample submittals to demonstrate aesthetic effects and to set quality standards for fabrication and installation.

1.7 WARRANTY

- A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Delta units when tested in accordance with ASTM D2244.
 - b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Finish Warranty Period: 20 years from date of Substantial Completion.
- B. Special Weathertightness Warranty: Installer's standard form in which the installer agrees to repair or replace the reused and repaired standing-seam copper roof panel assemblies that fail to remain weathertight, including leaks, within specified warranty period.
 - 1. Warranty Period: 5 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General: Sheet metal flashing and trim assemblies shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.
- B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.
- C. SPRI Wind Design Standard: Manufacture and install copings roof edge flashings tested in accordance with ANSI/SPRI/FM 4435/ES-1 and capable of resisting the following design pressure:
 - 1. Design Pressure: As indicated on Drawings.
- D. FM Approvals Listing: Manufacture and install copings and roof edge flashings that are listed in FM Approvals' "RoofNav" and approved for windstorm classification, Class 1-90. Identify materials with name of fabricator and design approved by FM Approvals.
- E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 SHEET METALS

- A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.
- B. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304, dead soft, fully annealed; 2B (bright, cold rolled) finish.
- C. Copper Patinaed Sheet:
 - 1. Surface: Smooth, flat.

2. Color: Natural Patina; Field-Patinaed

2.3 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Sheet: Minimum 30 mils (0.76 mm) thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer according to written recommendations of underlayment manufacturer.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Carlisle Coatings & Waterproofing Inc.
 - b. Carlisle Residential; a division of Carlisle Construction Materials.
 - c. Grace Construction Products; W.R. Grace & Co. -- Conn.
 - d. Henry Company.
 - e. Substitutions: See Section 012500 - Substitution Procedures.
 2. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F (116 deg C) or higher.
 3. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F (29 deg C) or lower.

2.4 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, solder, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal unless otherwise indicated.
- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal.
 1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
 - a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
 - b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
 - c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.
 2. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.
- C. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.
- D. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- E. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.
- F. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.

- G. Bituminous Coating: Cold-applied asphalt emulsion according to ASTM D 1187.
- H. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.5 FABRICATION, GENERAL

- A. General: Custom fabricate sheet metal flashing and trim to comply with details shown and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
 - 1. Obtain field measurements for accurate fit before shop fabrication.
 - 2. Form sheet metal flashing and trim to fit substrates without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
 - 3. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.
- B. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.
 - 1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with butyl sealant concealed within joints.
 - 2. Use lapped expansion joints only where indicated on Drawings.
- C. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal to provide for proper installation of elastomeric sealant according to cited sheet metal standard.
- D. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard for application, but not less than thickness of metal being secured.
- E. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.

2.6 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

- A. Drip Edges: Fabricate from the following materials:
 - 1. Galvanized Steel: 24 Gage, 0.022 inch (0.56 mm) thick.
- B. Base Flashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:
 - 1. Galvanized Steel: 24 Gage, 0.022 inch (0.56 mm) thick.
- C. Counterflashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:
 - 1. Galvanized Steel: 24 Gage, 0.022 inch (0.56 mm) thick.
- D. Roof-Penetration Flashing: Fabricate from the following materials:
 - 1. Galvanized Steel: 0.028 inch (0.71 mm) thick.

2.7 WALL SHEET METAL FABRICATIONS

- A. Through-Wall Flashing: Fabricate continuous flashings in minimum 96-inch- (2400-mm-) long, but not exceeding 12-foot- (3.6-m-) long, sections, under copings, and at shelf angles. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches (150 mm) beyond each side of wall openings; and form with 2-inch- (50-mm-) high, end dams. Fabricate from the following materials:
 - 1. Stainless Steel: 0.016 inch (0.40 mm) thick.
- B. Opening Flashings in Frame Construction: Fabricate head, sill, jamb, and similar flashings to extend 4 inches (100 mm) beyond wall openings. Form head and sill flashing with 2-inch- (50-mm-) high, end dams. Fabricate from the following materials:

1. Stainless Steel: 0.016 inch (0.40 mm) thick.

PART 3 - EXECUTION

3.1 UNDERLAYMENT INSTALLATION

- A. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free. Prime substrate if recommended by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures. Apply in shingle fashion to shed water, with end laps of not less than 6 inches (150 mm) staggered 24 inches (600 mm) between courses. Overlap side edges not less than 3-1/2 inches (90 mm). Roll laps and edges with roller. Cover underlayment within 14 days.

3.2 INSTALLATION, GENERAL

- A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
 1. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
 2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
 3. Space cleats not more than 12 inches (300 mm) apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
 4. Install exposed sheet metal flashing and trim with limited oil canning, and free of buckling and tool marks.
 5. Torch cutting of sheet metal flashing and trim is not permitted.
- B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.
 1. Coat concealed side of stainless-steel sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
 2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.
- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at maximum of 10 feet (3 m) with no joints within 24 inches (600 mm) of corner or intersection.
 1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with sealant concealed within joints.
 2. Use lapped expansion joints only where indicated on Drawings.
- D. Fasteners: Use fastener sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches (32 mm) for nails and not less than 3/4 inch (19 mm) for wood screws.

- E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.
- F. Seal joints as required for watertight construction. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."
- G. Rivets: Rivet joints in uncoated aluminum where necessary for strength.

3.3 INSTALLATION OF ROOF FLASHINGS

- A. Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and cited sheet metal standard.
 - 1. Provide concealed fasteners where possible, and set units true to line, levels, and slopes.
 - 2. Install work with laps, joints, and seams that are permanently watertight and weather resistant.
- B. Roof Edge Flashing:
 - 1. Install roof edge flashings in accordance with ANSI/SPRI/FM 4435/ES-1.
- C. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending minimum of 4 inches (100 mm) over base flashing. Install stainless steel draw band and tighten.
- D. Counterflashing: Coordinate installation of counterflashing with installation of base flashing.
 - 1. Insert counterflashing in reglets or receivers and fit tightly to base flashing.
 - 2. Extend counterflashing 4 inches (100 mm) over base flashing.
 - 3. Lap counterflashing joints minimum of 4 inches (100 mm).
- E. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with butyl sealant and clamp flashing to pipes that penetrate roof.

3.4 WALL FLASHING INSTALLATION

- A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.
- B. Through-Wall Flashing: Installation of through-wall flashing is specified in Section 042000 "Unit Masonry." Section 047200 "Cast Stone Masonry."
- C. Opening Flashings in Frame Construction: Install continuous head, sill, jamb, and similar flashings to extend 4 inches (100 mm) beyond wall openings.

3.5 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder.
- C. Clean off excess sealants.
- D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.

END OF SECTION 076200

SECTION 077100 - ROOF SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copings.
2. Roof-edge specialties.
3. Roof-edge drainage systems.
4. Reglets and counterflashings.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for downspout guards and downspout boots.
2. Section 061000 "Rough Carpentry" for wood nailers, curbs, and blocking.
3. Section 074113.16 "Standing-Seam Metal Roof Panels" for roof-edge drainage-system components provided by metal-roof-panel manufacturer.
4. Section 076200 "Sheet Metal Flashing and Trim" for custom- and site-fabricated sheet metal flashing and trim.
5. Section 077200 "Roof Accessories" for set-on-type curbs, equipment supports, roof hatches, vents, and other manufactured roof accessory units.
6. Section 079200 "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.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Copings.
2. Roof-edge specialties.
3. Roof-edge drainage systems.
4. Reglets and counterflashings.

- B. Product Data Submittals: For each product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- C. 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.
- D. Samples: For each type of roof specialty and for each color and texture specified.
- E. Samples for Initial Selection: For each type of roof specialty indicated with factory-applied color finishes.
- F. 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 roof-edge specialties made from 12-inch (300-mm) lengths of full-size components in specified material, and including fasteners, cover joints, accessories, and attachments.

1.3 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of roof specialty.
- B. Sample Warranty: For manufacturer's special warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For roofing specialties to include in maintenance manuals.

1.5 MOCKUPS

- A. Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
 - 1. Build mockup of typical roof edge, including fascia approximately 10 feet (3.0 m) long, including supporting construction, seams, attachments, underlayment, 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.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not store roof specialties in contact with other materials that might cause staining, denting, or other 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.

1.7 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.

1.8 WARRANTY

- A. Roofing-System Warranty: Roof specialties are included in warranty provisions in Section 075419 "POLYVINYL-CHLORIDE (PVC) ROOFING."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Roof specialties to 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 roof-edge specialties 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 roof-edge specialties tested in accordance with 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.

2.2 COPINGS

A. Metal Copings: Manufactured coping system consisting of metal coping cap in section lengths not exceeding 12 feet (3.6 m), concealed anchorage; with corner units, end cap units, and concealed splice plates with finish matching coping caps.

1. Formed Copper Sheet Coping Caps: Copper sheet, 20 oz./sq. ft. (0.68 mm) thick.

a. Copper Finish: Field-Patinaed, Verdigris.

2. Corners: Factory mitered and soldered.

3. Coping-Cap Attachment Method: face leg hooked to continuous cleat with back leg fastener exposed, fabricated from coping-cap material.

a. Face-Leg Cleats: Concealed, continuous stainless steel.

2.3 ROOF-EDGE SPECIALTIES

A. Canted Roof-Edge Fascia and Gravel Stop: Manufactured, two-piece, roof-edge fascia consisting of compression-clamped metal fascia cover in section lengths not exceeding 12 feet (3.6 m) and a continuous formed gal sheet cant, 0.028 inch (0.71 mm) thick, minimum, with extended vertical leg terminating in a drip-edge cleat. Provide matching corner units.

1. Formed Copper Sheet Gravel Stops: Copper sheet, 20 oz./sq. ft. (0.68 mm thick).

a. Copper Finish: Field-Patinaed, Verdigris.

2. Corners: Factory mitered and soldered.

2.4 ROOF-EDGE DRAINAGE SYSTEMS

A. Parapet Scuppers: Manufactured with closure flange trim to exterior, 4-inch- (100-mm-) wide wall flanges to interior, and base extending 4 inches (100 mm) beyond cant or tapered strip into field of roof.

1. Copper: 16 oz./sq. ft. (0.55 mm thick).

2.5 REGLETS AND COUNTERFLASHINGS

- A. Reglets: Manufactured units formed to provide secure interlocking of separate reglet and counterflashing pieces, from the following exposed metal:
1. Stainless Steel: 0.0188 inch (0.477 mm) thick.
 2. Copper: 16 oz./sq. ft. (0.55 mm thick).
 3. Corners: Factory mitered and soldered.
 4. 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.
- B. Counterflashings: Manufactured units of heights to overlap top edges of base flashings by 4 inches (100 mm) and in lengths not exceeding 12 feet (3.6 m) designed to snap into reglets or through-wall-flashing receiver and compress against base flashings with joints lapped, from the following exposed metal:
1. Stainless Steel: 0.0188 inch (0.477 mm) thick.
 2. Copper: 16 oz./sq. ft. (0.55 mm 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.
- D. Stainless Steel Finish: [ASTM A480/A480M No. 3 (coarse, polished directional satin).
- E. Copper Finish: Field-patinated verdigris.

2.6 MATERIALS

- A. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304.
- B. Copper Sheet: ASTM B370, cold-rolled copper sheet, H00 or H01 temper.

2.7 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils (0.76 to 1.0 mm) thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Carlisle Coatings & Waterproofing Inc.
 - b. Carlisle Residential; a division of Carlisle Construction Materials.

- c. Grace Construction Products; W.R. Grace & Co. -- Conn.
- d. Henry Company.
- e. Substitutions: See Section 012500 – Substitution Procedures.
2. Thermal Stability: ASTM D1970/D1970M; stable after testing at 240 deg F (116 deg C).
3. Low-Temperature Flexibility: ASTM D1970/D1970M; passes after testing at minus 20 deg F (29 deg C).

2.8 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 in accordance with ASTM A153/A153M or ASTM F2329.
- B. Elastomeric Sealant: ASTM C920, elastomeric silicone polymer sealant of type, grade, class, and use classifications required by roofing-specialty manufacturer for each application.
- C. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type joints with limited movement.
- D. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.
- E. Asphalt Roofing Cement: ASTM D4586, asbestos free, of consistency required for application.
- F. Solder for Copper: ASTM B32, lead-free solder.

2.9 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. Copper Sheet Finishes:

1. Field-Patinated Finish: Chemically treated in accordance with ASTM B882.

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 INSTALLATION OF UNDERLAYMENT

- 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 (152 mm) staggered 24 inches (610 mm) between courses. Overlap side edges not less than 3-1/2 inches (90 mm). Roll laps with roller. Cover underlayment within 14 days.
 1. Apply continuously under copings, roof-edge specialties, and reglets and counterflashings.
 2. Coordinate application of self-adhering sheet underlayment under roof specialties with requirements for continuity with adjacent air barrier materials.

3.3 INSTALLATION, GENERAL

- A. Install roof specialties in accordance with manufacturer's written instructions. Anchor roof specialties securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, underlayments, 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.

- 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 (3.6 m) with no joints within 18 inches (450 mm) of corners or intersections unless otherwise indicated on Drawings.
 - 2. When ambient temperature at time of installation is between 40 and 70 deg F (4 and 21 deg C), 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 (32 mm) for nails and not less than 3/4 inch (19 mm) for wood screws.
- 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 (4 deg C).
- 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 (38 mm); 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 INSTALLATION OF COPINGS

- 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-leg drip edge into continuous cleat anchored to substrate at 16-inch (406-mm) centers. Anchor back leg of coping with screw fasteners and elastomeric washers at 16-inch (406-mm) centers.

3.5 INSTALLATION OF ROOF-EDGE SPECIALITIES

- 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 INSTALLATION OF ROOF-EDGE DRAINAGE SYSTEMS

- A. Install components to produce a complete roof-edge drainage system in accordance with manufacturer's written instructions. Coordinate installation of roof perimeter flashing with installation of roof-edge drainage system.
 - 1. Provide elbows at base of downspouts at grade to direct water away from building.
 - 2. Connect downspouts to underground drainage system indicated.
- B. Splash Pans: Install where downspouts discharge on low-slope roofs. Set in elastomeric sealant.
- 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.

3.7 INSTALLATION OF REGLETS AND COUNTERFLASHINGS

- A. Coordinate installation of reglets and counterflashings with installation of base flashings.
- B. Embedded Reglets: See Section 033000 "Cast-in-Place Concrete" and Section 042000 "Unit Masonry" for installation of reglets.
- C. Surface-Mounted Reglets: Install reglets to receive flashings where flashing without embedded reglets is indicated on Drawings. Install at height so that inserted counterflashings overlap 4 inches (100 mm) over top edge of base flashings.
- D. Counterflashings: Insert counterflashings into reglets or other indicated receivers; ensure that counterflashings overlap 4 inches (100 mm) over top edge of base flashings. Lap counterflashing joints a minimum of 4 inches (100 mm) and bed with butyl sealant. Fit counterflashings 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

SECTION 077200 - ROOF ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

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

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of roof accessory.
- B. Shop Drawings: For roof accessories.
- C. Samples: For each exposed product and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS

- A. Sample warranties.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.5 WARRANTY

- A. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finishes or replace roof accessories that show evidence of deterioration of factory-applied finishes within 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 ROOF HATCH

- A. Roof Hatches: Metal roof-hatch units with lids and insulated single-walled curbs, welded or mechanically fastened and sealed corner joints, continuous lid-to-curb counterflashing and weathertight perimeter gasketing, straight sides, and integrally formed deck-mounting flange at perimeter bottom.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Bilco Company (The); Single Leaf Roof Scuttle Type E-50 or a comparable product by one of the following:
 - a. Architect approved equal. Substitutions: See Section 012500 - Substitution Procedures.
 - B. Type and Size: Single-leaf lid, 36 by 36 inches.
 - C. Hatch Material: Aluminum sheet.
 - 1. Thickness: Manufacturer's standard thickness for hatch size indicated.
 - 2. Finish: Mill.
 - D. Construction:
 - 1. Insulation: Cellulosic-fiber board.
 - 2. Nailer: Factory-installed wood nailer continuous around hatch perimeter.

3. Hatch Lid: Opaque, insulated, and double walled, with manufacturer's standard metal liner of same material and finish as outer metal lid.
 4. Curb Liner: Manufacturer's standard, of same material and finish as metal curb.
 5. Fabricate curbs to minimum height of 12 inches (305 mm) above roofing surface unless otherwise indicated.
- E. Hardware: Spring operators, hold-open arm, stainless-steel spring latch with turn handles, stainless-steel butt- or pintle-type hinge system, and padlock hasps inside and outside.
- F. Ladder-Assist Post: Roof-hatch manufacturer's standard device for attachment to roof-access ladder.
1. Operation: Post locks in place on full extension; release mechanism returns post to closed position.
 2. Height: 42 inches (1060 mm) above finished roof deck.
 3. Material: Aluminum.
 4. Post: 1-5/8-inch- (41-mm-) diameter pipe.
 5. Finish: Manufacturer's standard.
 - a. Color: As selected by Architect from manufacturer's full range.
- G. Safety Railing System: Roof-hatch manufacturer's standard system including rails, clamps, fasteners, safety barrier at railing opening, and accessories required for a complete installation; attached to roof hatch and complying with 29 CFR 1910.23 requirements and authorities having jurisdiction.
1. Height: 42 inches above finished roof deck.
 2. Posts and Rails: Galvanized-steel pipe, 1-1/4 inches
 3. Maximum Opening Size: System constructed to prevent passage of a sphere 21 inches (in diameter).
 4. Self-Latching Gate: Fabricated of same materials and rail spacing as safety railing system. Provide manufacturer's standard hinges and self-latching mechanism.
 5. Post and Rail Tops and Ends: Weather resistant, closed or plugged with prefabricated end fittings.
 6. Provide weep holes or another means to drain entrapped water in hollow sections of handrail and railing members.
 7. Fabricate joints exposed to weather to be watertight.
 8. Fasteners: Manufacturer's standard, finished to match railing system.
 9. Finish: Manufacturer's standard
 - a. Color: As selected by Architect from manufacturer's full range

2.2 METAL MATERIALS

- A. Aluminum Sheet: ASTM B 209 (ASTM B 209M), manufacturer's standard alloy for finish required, with temper to suit forming operations and performance required.
1. Mill Finish: As manufactured.
 2. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil (0.013 mm).
- B. Aluminum Extrusions and Tubes: ASTM B 221 (ASTM B 221M), manufacturer's standard alloy and temper for type of use, finished to match assembly where used; otherwise mill finished.
- C. Stainless-Steel Sheet and Shapes: ASTM A 240/A 240M or ASTM A 666, Type 304.
- D. Steel Shapes: ASTM A 36/A 36M, hot-dip galvanized according to ASTM A 123/A 123M unless otherwise indicated.

2.3 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.
- B. Cellulosic-Fiber Board Insulation: ASTM C 208, Type II, Grade 1, thickness as indicated.
- C. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, acceptable to authorities having jurisdiction, containing no arsenic or chromium, and complying with AWPA C2; not less than 1-1/2 inches (38 mm) thick.
- D. Underlayment:
 - 1. Felt: ASTM D 226/D 226M, Type II (No. 30), asphalt-saturated organic felt, nonperforated.
 - 2. Polyethylene Sheet: 6-mil- (0.15-mm-) thick polyethylene sheet complying with ASTM D 4397.
 - 3. Slip Sheet: Building paper, 3 lb/100 sq. ft. (0.16 kg/sq. m) minimum, rosin sized.
 - 4. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils (0.76 to 1.0 mm) thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.
 - 5. Fasteners: Roof accessory manufacturer's recommended fasteners suitable for application and metals being fastened. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners. Furnish the following unless otherwise indicated:
- E. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, PVC, or silicone or a flat design of foam rubber, sponge neoprene, or cork.
- F. Elastomeric Sealant: ASTM C 920, elastomeric polymer sealant as recommended by roof accessory manufacturer for installation indicated; low modulus; of type, grade, class, and use classifications required to seal joints and remain watertight.
- G. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for expansion joints with limited movement.
- H. Asphalt Roofing Cement: ASTM D 4586/D 4586M, asbestos free, of consistency required for application.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Verify dimensions of roof openings for roof accessories. Install roof accessories according to manufacturer's written instructions.
 - 1. Install roof accessories level; plumb; true to line and elevation; and without warping, jogs in alignment, buckling, or tool marks.
 - 2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
 - 3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
 - 4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.
- B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact

surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

1. Coat concealed side of uncoated aluminum and stainless-steel roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
 2. Underlayment: Where installing roof accessories directly on cementitious or wood substrates, install a course of underlayment and cover with manufacturer's recommended slip sheet.
- C. Seal joints with elastomeric or butyl sealant as required by roof accessory manufacturer.

3.2 REPAIR AND CLEANING

- A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing according to ASTM A 780/A 780M.
- B. Touch up factory-primed surfaces with compatible primer ready for field painting according to Section 099113 "Exterior Painting."
- C. Clean exposed surfaces according to manufacturer's written instructions.
- D. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 077200

SECTION 078100 - SPRAY-APPLIED FIRE RESISTIVE MATERIALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes Sprayed-Applied Fire-Resistive Materials (SFRMs).

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review products, design ratings, restrained and unrestrained conditions, densities, thicknesses, bond strengths, and other performance requirements.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Framing plans, schedules, or both, indicating the following:
 - 1. Extent of fireproofing for each construction and fire-resistance rating.
 - 2. Applicable fire-resistance design designations of a qualified testing and inspecting agency acceptable to authorities having jurisdiction.
 - 3. Minimum fireproofing thicknesses needed to achieve required fire-resistance rating of each structural component and assembly.
 - 4. Treatment of fireproofing after application.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and testing agency.
- B. Product Certificates: For each type of fireproofing.
- C. Evaluation Reports: For fireproofing, from third party.
- D. Preconstruction Test Reports: For fireproofing.
- E. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A firm or individual certified, licensed, or otherwise qualified by fireproofing manufacturer as experienced and with sufficient trained staff to install manufacturer's products according to specified requirements.
- B. Mockups: Build mockups Indicate portion of Work represented by mockup on Drawings or draw mockup as separate element.
 - 1. Build mockup of as part of a portion of work.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- C. It is recommended that industry guidelines as noted in National Fireproofing Contractors Association (NFCA) 100 - Standard Practice for the Application of Spray-Applied Fire Resistive Materials (SFRMs) be maintained on the project site.

1.7 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Owner will engage a qualified testing agency to perform preconstruction testing on fireproofing.
 - 1. Provide test specimens and assemblies representative of proposed materials and construction.
- B. Preconstruction Adhesion and Compatibility Testing: Test for compliance with requirements for specified performance and test methods.
 - 1. Bond Strength: Test for cohesive and adhesive strength according to ASTM E 736. Provide bond strength indicated in referenced fire-resistance design, but not less than minimum specified in Part 2.
 - 2. Density: Test for density according to ASTM E 605. Provide density indicated in referenced fire-resistance design, but not less than minimum specified in Part 2.
 - 3. Verify that manufacturer, through its own laboratory testing or field experience, attests that primers or coatings are compatible with fireproofing.
 - 4. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
 - 5. For materials failing tests, obtain applied-fireproofing manufacturer's written instructions for corrective measures including the use of specially formulated bonding agents or primers.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not apply fireproofing when ambient or substrate temperature is 40 deg F 4.4 deg C or lower unless temporary protection and heat are provided to maintain temperature at or above this level for 24 hours prior to, during, and for 24 hours after product application.

- B. Ventilation: Ventilate building spaces during and after application of fireproofing, providing a minimum 4 complete air exchanges per hour and according to manufacturer's written instructions until Spray-Applied Fire Resistive Materials are dried and cured. Use natural means or, if they are inadequate, forced-air circulation until fireproofing dries thoroughly.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Assemblies: Provide fireproofing, including auxiliary materials, according to requirements of each fire-resistance design and manufacturer's written instructions.
- B. Source Limitations: Obtain fireproofing from single source.
- C. Fire-Resistance Design: Indicated on Drawings, tested according to ASTM E 119/UL 263 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Steel members are to be considered unrestrained unless specifically noted otherwise.
- D. VOC Content: Products shall comply with VOC content limits of authorities having jurisdiction.
- E. Low-Emitting Materials: Fireproofing used within the weatherproofing system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- F. Asbestos: Provide products containing no detectable asbestos.

2.2 SPRAY-APPLIED FIRE RESISTIVE MATERIALS

- A. SFRM: Manufacturer's standard, factory-mixed, lightweight, dry formulation, complying with indicated fire-resistance design and mixed with water at Project site to form a slurry or mortar before conveyance and application or conveyed in a dry state and mixed with atomized water at place of application.
- B. Products: Subject to compliance with requirements, provide one of the following:
 - 1. Concealed/Commercial SFRMs:
 - a. ISOLATEK International: CAFCO® 300 Series (ISOLATEK® Type 300 Series), CAFCO® BLAZE-SHIELD® II (ISOLATEK® Type II)
 - 1) Substitutions: See Section 012500 - Product Requirements.
 - b. Physical Properties:
 - 1) Bond Strength: Minimum 150-lbf/sq. ft. (7.18-kPa) cohesive and adhesive strength based on field testing according to ASTM E 736.
 - 2) Density: Not less than 15 lb/cu. ft. (240 kg/cu. m) as specified in the approved fire-resistance design, according to ASTM E 605.

- 3) Thickness: As required for fire-resistance design indicated, measured according to requirements of fire-resistance design.
- 4) Combustion Characteristics: When tested in accordance with ASTM E 136 shall be noncombustible.
- 5) Surface-Burning Characteristics: When tested in accordance with ASTM E84 or CAN4-S102, the material shall exhibit the following surface burning characteristics:
 - a) Flame Spread Index [10] or less
 - b) Smoke Developed [10] or less
- 6) Compressive Strength: When tested in accordance with ASTM E761, the material shall not deform more than 10 percent when subjected to a crushing force of 1,440 psf (68.9 kPa).
- 7) Corrosion Resistance: No evidence of corrosion according to ASTM E 937.
- 8) Deflection: No cracking, spalling, or delamination according to ASTM E 759.
- 9) Effect of Impact on Bonding: No cracking, spalling, or delamination according to ASTM E 760.
- 10) Air Erosion: Maximum weight loss of 0.025 g/sq. ft. (0.270 g/sq. m) in 24 hours according to ASTM E 859.
- 11) Fungal Resistance: When tested in accordance with ASTM G21, the material shall show resistance to mold growth for a minimum period of 28

2.3 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that are compatible with fireproofing and substrates and are approved by UL or another testing and inspecting agency acceptable to authorities having jurisdiction for use in fire-resistance designs indicated.
- B. Substrate Primers: Primers approved by fireproofing manufacturer and complying with one or both of the following requirements:
 1. Fireproofing manufacturer shall be contacted for procedures on handling primed/painted steel.
 2. Primer's bond strength in required fire-resistance design complies with specified bond strength for fireproofing and with requirements in UL's "Fire Resistance Directory" or in the listings of another qualified testing agency acceptable to authorities having jurisdiction, based on a series of bond tests according to ASTM E 736.
- C. Bonding Agent: Product approved by fireproofing manufacturer and complying with requirements in UL's "Fire Resistance Directory" or in the listings of another qualified testing agency acceptable to authorities having jurisdiction.
- D. Metal Lath: Expanded metal lath fabricated from material of weight, configuration, and finish required, according to fire-resistance designs indicated and fireproofing manufacturer's written recommendations. Include clips, lathing accessories, corner beads, and other anchorage devices required to attach lath to substrates and to receive fireproofing.

- E. Reinforcing Fabric: Glass or carbon fiber fabric of type, weight, and form required to comply with fire-resistance designs indicated; approved and provided by fireproofing manufacturer.
- F. Reinforcing Mesh: Metallic mesh reinforcement of type, weight, and form required to comply with fire-resistance design indicated; approved and provided by fireproofing manufacturer. Include pins and attachment.
- G. Sealer: If required, a transparent-drying, water-dispersible, tinted protective coating as recommended by fireproofing manufacturer.
 - 1. Product: Subject to compliance with requirements, provide CAFCO® BOND-SEAL (ISOLATEK® Type EBS) or CAFCO® BOND-SEAL Type X (ISOLATEK® Type X) by ISOLATEK International.
- H. Topcoat: If required, a topcoat suitable for application over applied fireproofing; of type recommended by fireproofing manufacturer.
 - 1. Cement-Based Topcoat: Factory-mixed, cementitious hard-coat formulation for trowel or spray application over SFRM.
 - a. Product: Subject to compliance with requirements, provide CAFCO® FENDOLITE® M-II (ISOLATEK® Type M-II), CAFCO® FENDOLITE® TG (ISOLATEK® Type TG) by ISOLATEK International.
 - 2. Water-Based Permeable Topcoat: Factory-mixed formulation for brush, roller, or spray application over applied SFRM. Provide application at a rate of [30 sq. ft./gal. (0.75 sq. m/L)] [60 sq. ft./gal. (1.5 sq. m/L)] [120 sq. ft./gal. (3 sq. m/L)].
 - a. Product: Subject to compliance with requirements, provide CAFCO® TOP-COTE (ISOLATEK® Type TOP-COTE) by ISOLATEK International.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrates and other conditions affecting performance of the Work and according to each fire-resistance design. Verify compliance with the following:
 - 1. Substrates are free of dirt, oil, grease, release agents, rolling compounds, mill scale, loose scale, incompatible primers, paints, and encapsulants, or other foreign substances capable of impairing bond of fireproofing with substrates under conditions of normal use or fire exposure.
 - 2. Clips, hangers, supports, sleeves and other attachments to the substrate are to be placed by others prior to the application of the fireproofing materials.
 - 3. The installation of ducts, piping, conduit or other suspended equipment shall not take place until the application of the fireproofing is complete in an area.

- B. Fire protection shall not be applied to steel floor decks prior to the completion of concrete work on that deck.
- C. The application of fireproofing to the underside of roof deck shall not commence until the roof is completely installed and tight, all penthouses are complete, all mechanical units have been placed, and construction roof traffic has ceased. When roof traffic is anticipated, as in the case of periodic maintenance, roofing pavers shall be installed as a walkway to distribute loads.
- D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Cover other work subject to damage from fallout or overspray of fireproofing materials during application.
- B. Clean substrates of substances that could impair bond of fireproofing.
- C. For applications visible on completion of Project, repair substrates to remove surface imperfections that could affect uniformity of texture and thickness in finished surface of fireproofing. Remove minor projections and fill voids that would telegraph through fire-resistant products after application.

3.3 APPLICATION

- A. Construct fireproofing assemblies that are identical to fire-resistance design indicated and products as specified, tested, and substantiated by test reports for thickness, primers, sealers, topcoats, finishing, and other materials and procedures affecting fireproofing work.
- B. Comply with fireproofing manufacturer's written instructions for mixing materials, application procedures, and types of equipment used to mix, convey, and apply fireproofing as applicable to particular conditions of installation and as required to achieve fire-resistance ratings indicated.
- C. Coordinate application of fireproofing with other construction to minimize need to cut or remove fireproofing.
 - 1. Do not begin applying fireproofing until clips, hangers, supports, sleeves, and other items penetrating fireproofing are in place.
 - 2. Defer installing ducts, piping, and other items that would interfere with applying fireproofing until application of fireproofing is completed.
- D. Metal Decks:
 - 1. Do not apply fireproofing to underside of metal deck substrates until concrete topping, if any, has been completed.

2. Do not apply fireproofing to underside of metal roof deck until roofing has been completed; prohibit roof traffic during application and drying of fireproofing.
 3. When roof traffic is anticipated, as in the case of periodic maintenance, roofing pavers shall be installed as a walkway to distribute loads.
- E. Install auxiliary materials as required, as detailed, and according to fire-resistance design and fireproofing manufacturer's written recommendations for conditions of exposure and intended use. For auxiliary materials, use attachment and anchorage devices of type recommended in writing by fireproofing manufacturer.
- F. Spray apply fireproofing to maximum extent possible. Following the spraying operation in each area, complete the coverage by trowel application or other placement method recommended in writing by fireproofing manufacturer.
- G. Extend fireproofing in full thickness over entire area of each substrate to be protected.
- H. Install body of fireproofing in a single course unless otherwise recommended in writing by fireproofing manufacturer.
- I. For applications over encapsulant materials, including lockdown (post-removal) encapsulants, apply fireproofing that differs in color from that of encapsulant over which it is applied.
- J. Where sealers are used, apply products that are tinted to differentiate them from fireproofing over which they are applied.
- K. Provide a uniform finish complying with description indicated for each type of fireproofing material and matching finish approved for required mockups.
- L. Cure fireproofing according to fireproofing manufacturer's written recommendations.
- M. Do not install enclosing or concealing construction until after fireproofing has been applied, inspected, and tested and corrections have been made to deficient applications.
- N. Finishes: Where indicated, apply fireproofing to produce the following finishes:
1. Manufacturer's Standard Finishes: Finish according to manufacturer's written instructions for each finish selected.
 2. Spray-Textured Finish: Finish left as spray-applied with no further treatment.
 3. Rolled, Spray-Textured Finish: Even finish produced by rolling spray-applied finish with a damp paint roller to remove drippings and excessive roughness.
 4. Skip-Troweled Finish: Even leveled surface produced by troweling spray-applied finish to smooth out the texture and neaten edges.
 5. Skip-Troweled Finish with Corner Beads: Even, leveled surface produced by troweling spray-applied finish to smooth out the texture, eliminate surface markings, and square off edges.

3.4 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
 - 1. Test and inspect as required by Chapter 17 of the IBC.
 - 2. For reference, utilize AWCI - Inspection Procedure for Field-Applied Sprayed Fire-Resistive Materials, Technical Manual 12-A; an annotated guide.
- B. Test and inspect completed work in successive stages. Do not proceed with application of fireproofing for the next area until test results for previously completed applications of fireproofing show compliance with requirements. Tested values must equal or exceed values as specified and as indicated and required for approved fire-resistance design.
- C. Application will be considered defective if it does not pass tests and inspections.
 - 1. Remove and replace fireproofing that does not pass tests and inspections, and retest.
 - 2. Apply additional fireproofing, per manufacturer's written instructions, where test results indicate insufficient thickness, and retest.
- D. Prepare test and inspection reports.

3.5 CLEANING, PROTECTING, AND REPAIRING

- A. Cleaning: Immediately after completing spraying operations in each containable area of project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.
- B. Protect fireproofing, according to advice of manufacturer and installer, from damage resulting from construction operations or other causes, so fireproofing will be without damage or deterioration at time of Substantial Completion.
- C. As installation of other construction proceeds, inspect fireproofing and repair damaged areas and fireproofing removed due to work of other trades.
- D. Repair fireproofing damaged by other work before concealing it with other construction.
- E. Repair fireproofing by reapplying it using same method as original installation or using manufacturer's recommended trowel-applied product.

END OF SECTION 078100

SECTION 078413 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Penetrations in fire-resistance-rated walls.
 - 2. Penetrations in horizontal assemblies.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.
 - 1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

1.3 CLOSEOUT SUBMITTALS

- A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics:
 - 1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
 - 2. Test per testing standards referenced in "Penetration Firestopping Systems" Article. Provide rated systems complying with the following requirements:
 - a. Penetration firestopping systems shall bear classification marking of a qualified testing agency.
 - 1) UL in its "Fire Resistance Directory."
 - 2) Intertek Group in its "Directory of Listed Building Products."
 - 3) FM Global in its "Building Materials Approval Guide."

2.2 PENETRATION FIRESTOPPING SYSTEMS

- A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction

penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.

1. Products: Subject to compliance with requirements, provide penetration firestopping systems that are produced by one of the following manufacturers:
 - a. A/D Fire Protection Systems Inc.
 - b. Grace Construction Products.
 - c. Hilti, Inc.
 - d. Johns Manville.
 - e. Nelson Firestop Products.
 - f. NUCO Inc.
 - g. Passive Fire Protection Partners.
 - h. RectorSeal Corporation.
 - i. Specified Technologies Inc.
 - j. 3M Fire Protection Products.
 - k. Tremco, Inc.; Tremco Fire Protection Systems Group.
 - l. USG Corporation.
 - m. Substitutions: See Section 012500 – Substitution Procedures.
- B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).
 1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
- C. Penetrations in Horizontal Assemblies: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).
 1. F-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated.
 2. T-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
 3. W-Rating: Provide penetration firestopping systems showing no evidence of water leakage when tested according to UL 1479.
- D. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E 84.
- E. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.
- B. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.
- C. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings.

1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.
- D. Install fill materials by proven techniques to produce the following results:
 1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
 3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.2 FIELD QUALITY CONTROL

- A. Owner may engage a qualified testing agency to perform tests and inspections according to ASTM E 2174.
- B. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.
- C. Proceed with enclosing penetration firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

END OF SECTION 078413

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes joint sealants for the following applications, including those specified by reference to this Section and following applications:
 - 1. Exterior joints in the following vertical surfaces and horizontal nontraffic surfaces:
 - a. Control and expansion joints in unit masonry and stone cladding.
 - b. Joints between different materials.
 - c. Perimeter joints between materials and frames of doors, windows and louvers.
 - d. Other joints as indicated.
 - 2. Exterior joints in the following horizontal traffic surfaces:
 - a. Isolation and contraction joints in cast-in-place concrete slabs.
 - b. Other joints as indicated.
 - 3. Interior joints in the following vertical surfaces and horizontal nontraffic surfaces:
 - a. Control and expansion joints on exposed interior surfaces of exterior walls.
 - b. Perimeter joints of exterior openings where indicated.
 - c. Tile control and expansion joints.
 - d. Vertical joints on exposed surfaces of interior unit masonry walls and partitions.
 - e. Vertical joints on exposed surfaces of interior ceramic tile.
 - f. Perimeter joints between interior wall surfaces and frames of interior doors and windows.
 - g. Joints between plumbing fixtures and adjoining walls, floors, and counters.
 - h. Other joints as indicated.
 - 4. Interior joints in the following horizontal traffic surfaces:
 - a. Isolation joints in cast-in-place concrete slabs.
 - b. Joints in tile flooring.
 - c. Other joints as indicated.
- B. See Division 8 Section "Glazing" for glazing sealants.

1.2 PERFORMANCE REQUIREMENTS

- A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.
- B. Provide joint sealants for interior applications that establish and maintain airtight and water-resistant continuous joint seals without staining or deteriorating joint substrates.

1.3 SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. Samples: For each type and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- (13-mm-) wide joints formed between two 6-inch- (150-mm-) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

1.4 QUALITY ASSURANCE

- A. Preconstruction Field-Adhesion Testing: Before installing elastomeric sealants, field test their adhesion to Project joint substrates according to the method in ASTM C 1193 that is appropriate for the types of Project joints.

1.5 WARRANTY

- A. Special Installer's Warranty: Installer's standard form in which Installer agrees to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer's standard form in which elastomeric sealant manufacturer agrees to furnish elastomeric joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles.

2.2 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.
- B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.3 ELASTOMERIC JOINT SEALANTS

- A. Elastomeric Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
- B. Stain-Test-Response Characteristics: Where elastomeric sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.
- C. Suitability for Immersion in Liquids. Where elastomeric sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C 1247 and qualify for the length of exposure indicated by reference to ASTM C 920 for Class 1 or 2. Liquid used for testing sealants is deionized water, unless otherwise indicated.
- D. Suitability for Contact with Food: Where elastomeric sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.

- E. Low-Modulus Neutral -Curing Polyurethane Sealant: Where joint sealants of this type are indicated, provide products complying with the following:
1. Available Products:
 - a. Pecora Corporation; Dynatrol I-XL.
 - b. Tremco; DyMonic.
 - c. Tremco; Vulkem 921.
 - d. Substitutions: See Section 012500 - Substitution Procedures.
 2. Type and Grade: S (single component) and NS (nonsag).
 3. Class: 25.
 4. Use Related to Exposure: NT (nontraffic).
 5. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.
 - a. Coated glass, aluminum coated with a high-performance coating, color anodic aluminum, galvanized steel, brick, limestone, marble, granite, plastic, tile, wood.
- F. Single-Component Mildew-Resistant Acid-Curing Silicone Sealant: Where joint sealants of this type are indicated, provide products formulated with fungicide that are intended for sealing interior ceramic tile joints and other nonporous substrates that are subject to in-service exposures of high humidity and temperature extremes, and that comply with the following:
1. Available Products:
 - a. Dow Corning Corporation; 786 Mildew Resistant.
 - b. GE Silicones; Sanitary SCS1700.
 - c. Tremco; Tremsil 200 White.
 - d. Substitutions: See Section 012500 - Substitution Procedures.
 2. Type and Grade: S (single component) and NS (nonsag).
 3. Class: 25.
 4. Use Related to Exposure: NT (nontraffic).
 5. Uses Related to Joint Substrates: G, A, and, as applicable to joint substrates indicated, O.
 - a. Coated glass, aluminum coated with a high-performance coating, color anodic aluminum, galvanized steel, marble, granite, plastic and tile.
- G. Single-Component Pourable Urethane Sealant: Where joint sealants of this type are indicated, provide products complying with the following:
1. Available Products:
 - a. Pecora Corporation; Urexpan NR-201.
 - b. Polymeric Systems Inc.; Flexiprene 952.
 - c. Tremco; Tremflex S/L.
 - d. Tremco; Vulkem 45.
 - e. Sonneborn Building Products, Div., ChemRex Inc.; SL 1.
 - f. Substitutions: See Section 012500 - Substitution Procedures.
 2. Type and Grade: S (single component) and P (pourable).
 3. Class: 25.
 4. Use Related to Exposure: T (traffic) and NT (nontraffic).
 5. Uses Related to Joint Substrates: M, A, and, as applicable to joint substrates indicated, O.
 - a. Color anodic aluminum, aluminum coated with a high-performance coating, galvanized steel, brick, granite, marble, ceramic tile and wood.

2.4 LATEX JOINT SEALANTS

- A. Latex Sealant: Comply with ASTM C 834, Type OP, Grade NF.
B. Available Products:

1. Pecora Corporation; AC-20+.
2. Sonneborn, Division of ChemRex Inc.; Sonolac.
3. Tremco; Tremflex 834.
4. Substitutions: See Section 012500 - Substitution Procedures.

2.5 JOINT-SEALANT BACKING

- A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), O (open-cell material), B (bicellular material with a surface skin) or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:
- C. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D 1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 26 deg F (minus 32 deg C). Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and to otherwise contribute to optimum sealant performance.
- D. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.6 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants.
 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant.
 - a. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning

- operations above by vacuuming or blowing out joints with oil-free compressed air.
2. Remove laitance and form-release agents from concrete.
 - a. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.
 - B. Joint Priming: Prime joint substrates, where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
 - C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.2 INSTALLATION

- A. General: All dissimilar materials are to be caulked.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 1. Do not leave gaps between ends of sealant backings.
 2. Do not stretch, twist, puncture, or tear sealant backings.
 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 1. Place sealants so they directly contact and fully wet joint substrates.
 2. Completely fill recesses in each joint configuration.
 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
 1. Remove excess sealant from surfaces adjacent to joints.
 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 3. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.
- G. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.
- H. Arrange with manufacturer's rep to conduct a pull test in field to determine adhesion of the sealant to substrate conditions found.

3.3 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Exterior horizontal nontraffic and traffic, isolation and contraction joints in cast-in-place concrete slabs.
 - 1. Joint Sealant: Single-component pourable urethane sealant.
 - 2. Joint-Sealant Color: As selected by Architect from Manufacturers full color range.
- B. Joint-Sealant Application: Exterior vertical control and expansion joints in unit masonry and stone cladding.
 - 1. Joint Sealant: Low- Modulus Neutral-Curing Polyurethane Sealant.
 - 2. Joint-Sealant Color: As selected by Architect from Manufacturers full color range.
- C. Joint-Sealant Application: Exterior vertical and horizontal joints between different materials.
 - 1. Joint Sealant: Low- Modulus Neutral-Curing Polyurethane Sealant.
 - 2. Joint-Sealant Color: As selected by Architect from Manufacturers full color range.
- D. Joint-Sealant Application: Exterior perimeter joints between masonry and frames of doors and windows.
 - 1. Joint Sealant: Low- Modulus Neutral-Curing Polyurethane Sealant.
 - 2. Joint-Sealant Color: As selected by Architect from Manufacturers full color range.
- E. Joint-Sealant Application: Vertical control and expansion joints on exposed interior surfaces of exterior walls.
 - 1. Joint Sealant: Latex sealant.
 - 2. Joint-Sealant Color: As selected by Architect from Manufacturers full color range.
- F. Joint-Sealant Application: Interior perimeter joints of exterior openings.
 - 1. Joint Sealant: Latex sealant.
 - 2. Joint-Sealant Color: As selected by Architect from Manufacturers full color range.
- G. Joint-Sealant Application: Interior ceramic tile joints in horizontal traffic surfaces.
 - 1. Joint Sealant: Single-component, neutral curing, 100% silicone sealant. Same manufacturer as ceramic tile grout manufacturer.
 - 2. Joint-Sealant Color: As selected by Architect from Manufacturers full color range to match grout color.
- H. Joint-Sealant Application: Interior joints between plumbing fixtures and adjoining walls, floors, and counters.
 - 1. Joint Sealant: Single-component mildew-resistant acid-curing silicone sealant.
 - 2. Joint-Sealant Color: As selected by Architect from Manufacturers full color range.
- I. Joint-Sealant Application: Vertical joints on exposed surfaces of interior unit masonry walls and partitions.
 - 1. Joint Sealant: Latex sealant.
 - 2. Joint-Sealant Color: As selected by Architect from Manufacturers full color range.
- J. Joint-Sealant Application: Perimeter joints between interior wall surfaces and frames of interior doors and windows.
 - 1. Joint Sealant: Latex sealant.
 - 2. Joint-Sealant Color: As selected by Architect from Manufacturer's full color range.

END OF SECTION 079200

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes hollow metal doors and frames.

1.2 SUBMITTALS

- A. Product Data: For each product indicated. Include door designation, type, level and model, material description, label compliance, fire-resistance ratings, and finishes.
- B. Shop Drawings: Include elevations, door edge details, frame profiles, metal thicknesses, preparations for hardware, and other details.
- C. Door Schedule. Use same reference designations indicated on Drawings.

1.3 QUALITY ASSURANCE

- A. Steel Door and Frame Standard: Comply with ANSI A 250.8 unless more stringent requirements are indicated.
- B. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 252.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Amweld International, LLC.
 - 2. Ceco Door Products; an Assa Abloy Group Company.
 - 3. Curries Company; an Assa Abloy Group Company.
 - 4. Mesker Door, Inc.
 - 5. Pioneer Industries Inc.
 - 6. Republic Doors and Frames.
 - 7. Steelcraft; an Ingersoll-Rand Company.
 - 8. Substitutions: See Section 012500 - Substitution Procedures.

2.2 MATERIALS

- A. Hot-Rolled Steel Sheets: ASTM A 569/A 569M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- B. Cold-Rolled Steel Sheets: ASTM A 366/A 366M, Commercial Steel (CS), or ASTM A 620/A 620M, Drawing Steel (DS), Type B; stretcher-leveled standard of flatness.
- C. Metallic-Coated Steel Sheets: ASTM A 653/A 653M, Commercial Steel (CS), Type B, with an A40 (ZF120) zinc-iron-alloy (galvannealed) coating; stretcher-leveled standard of flatness.

2.3 DOORS

- A. Interior Doors: Complying with ANSI 250.8 for level and model and ANSI A250.4 for physical-endurance level indicated.
 - 1. Interior Doors (Extra-Heavy-Duty Doors) Level 3 and Physical Performance Level A, Model 1 (Full Flush) 0.053-inch-thick (16 gage).

2.4 FRAMES

- A. General: ANSI A250.8; conceal fastenings, unless otherwise indicated.
- B. Frame Steel Sheet Thickness:
 - 1. Interior Frames of minimum 0.053-inch-thick (16 gage) for level 3 steel doors and wood doors.
- C. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
- D. Construction: Full profile welded.
- E. Door Silencers: Three silencers on single-door frames and two silencers on double-door frames.
- F. Jamb Anchors:
 - 1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch (1.0 mm) thick, with corrugated or perforated straps not less than 2 inches (51 mm) wide by 10 inches (254 mm) long; or wire anchors not less than 0.177 inch (4.5 mm) thick.
 - 2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch (1.0 mm) thick.
- G. Inserts, Bolts, and Fasteners: Manufacturer's standard units. Zinc-coat items that are to be built into exterior walls according to ASTM A 153/A 153M, Class C or D as applicable.
- H. Grout: Where required in masonry construction, as specified in Division 4 "Unit Masonry."

2.5 FABRICATION

- A. General: Fabricate steel door and frame units to comply with ANSI A250.8 free from defects including warp and buckle. Where practical, fit and assemble units in manufacturer's plant.
- B. Interior Door and Panel Faces: Fabricate exposed faces of doors and panels, including stiles and rails of nonflush units, from cold-rolled steel sheet.
- C. Core Construction: Manufacturer's standard core construction that produces a door complying with SDI standards.
- D. Clearances for Non-Fire-Rated Doors: Not more than 1/8 inch (3.2 mm) at jambs and heads, except not more than 1/4 inch (6.4 mm) between pairs of doors. Not more than 3/4 inch (19 mm) at bottom.
- E. Clearances for Fire-Rated Doors: As required by NFPA 80.
- F. Door-Edge Profile: Square edge unless beveled edge is indicated.
- G. Tolerances: Comply with SDI 117.
- H. Prepare doors and frames to receive mortised and concealed hardware according to final door hardware schedule and templates provided by hardware supplier. Comply with applicable requirements in ANSI A250.6 and ANSI A115 Series specifications for door and frame preparation for hardware.
- I. Frame Construction:
 - 1. Fabricate frames with mitered or coped and continuously welded corners and seamless face joints. Provide temporary spreader bars.
 - 2. Provide terminated stops, where indicated.
- J. Reinforce doors and frames to receive surface-applied hardware. Drilling and tapping for surface-applied hardware may be done at Project site.
- K. Locate hardware as indicated or, if not indicated, according to ANSI A250.8.
- L. Glazing Stops: Manufacturer's standard, formed from 0.032-inch- (0.8-mm-) thick steel sheet.
 - 1. Provide nonremovable stops on secure side of interior doors for glass, louvers, and other panels in doors.
 - 2. Provide screw-applied, removable, glazing stops on inside of glass, louvers, and other panels in doors.

- M. Astragals: As required by NFPA 80 to provide fire ratings indicated.
- N. Where hollow metal frames are to be inserted into the fire rated steel frame the width of the hollow metal frame shall match the width of the fire rated steel frame.
- O. Coordinate with the fire rated steel frame manufacturer to insure that the total assembly meets the specified fire rating for the entire opening.

2.6 FINISHES

- A. Prime Finish: Manufacturer's standard, factory-applied coat of rust-inhibiting primer complying with ANSI A250.10 for acceptance criteria.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Placing Frames: Comply with provisions in SDI 105, unless otherwise indicated. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders, leaving surfaces smooth and undamaged.
 - 1. Wall Anchors: Provide at least three anchors per jamb. For openings 90 inches (2286 mm) or more in height, install an additional anchor at hinge and strike jambs.
 - 2. Fire-Rated Frames: Install according to NFPA 80.
- B. Door Installation: Comply with ANSI A250.8. Shim as necessary to comply with SDI 122 and ANSI/DHI A115.1G.
 - 1. Fire-Rated Doors: Install within clearances specified in NFPA 80.
 - 2. Smoke Control Doors: Install to comply with NFPA 105.
- C. Prime Coat Touchup: Immediately after installation, sand smooth any rusted or damaged areas of prime coat and apply touchup of compatible air-drying primer.
- D. After installation, remove protective wrappings from doors and frames and touch up prime coat with compatible air-drying primer.

END OF SECTION 081113

SECTION 081416 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Solid-core doors with wood veneer faces.
 - 2. Factory finishing flush wood doors.
 - 3. Factory fitting flush wood doors to frames and factory machining for hardware.

1.2 SUBMITTALS

- A. Product Data: For each type of door. Include factory-finishing specifications.
- B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details; location and extent of hardware blocking; mortises, holes, and cutouts; requirements for veneer matching; factory finishing; fire ratings; and other pertinent data.
- C. Samples: For each face material and finish.
 - 1. Provide samples of custom stain color for Architects approval.

1.3 QUALITY ASSURANCE

- A. Quality Standard: Comply with AWI's "Architectural Woodwork Quality Standards Illustrated."
- B. Fire-Rated Wood Doors: Doors that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated.

1.4 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install doors until building is enclosed, wet-work is complete and HVAC system is operating and will maintain temperature and relative humidity at occupancy levels during the remainder of the construction period.

1.5 WARRANTY

- A. General Warranty: Door manufacturer's warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. Door Manufacturer's Warranty: Submit written agreement on door manufacturer's standard form, signed by manufacturer, Installer, and Contractor, agreeing to repair or replace defective doors that have warped (bow, cup or twist) more than 1/4 inch in a 42-by-84-inch section or that show telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span, or do not comply with tolerances in referenced quality standard.
 - 1. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
 - 2. Warranty shall be in effect during the following period of time after the date of Substantial Completion:
 - a. Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Algoma Hardwoods, Inc.
 2. Eggers Industries.
 3. Graham; an Assa Abloy Group company.
 4. Marshfield Door Systems, Inc.
 5. Mohawk Flush Doors, Inc.
 6. Oshkosh Door Company.
 7. VT Industries, Inc.
 8. Substitutions: See Section 012500 - Substitution Procedures.

2.2 DOOR CONSTRUCTION

- A. Doors for Transparent Finish:
1. Grade: Premium, with Grade A faces.
 2. Species and Cut: Plain sliced White Birch.
 3. Match between Veneer Leaves: Book match.
 4. Assembly of Veneer Leaves on Door Faces: Center balance match.
 5. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
 6. Stiles: Applied wood edges of same species as faces applied before veneering faces.
- B. Interior Veneer-Faced Solid-Core Doors:
1. Core: Particleboard.
 2. Construction: Five plies with cross-band, stiles and rails bonded to core, then entire unit abrasive planed before veneering.
- C. Fire-Rated Doors:
1. Construction: Construction and core specified above for type of face indicated or manufacturer's standard mineral-core construction as needed to provide fire rating indicated.
 2. Edge Construction: Intumescent seals concealed by outer stile matching face veneer, and laminated backing for improved screw-holding capability and split resistance.
 3. Pairs: Furnish formed-steel edges and astragals for pairs of fire-rated doors, unless otherwise indicated.
- D. Blocking: For mineral-core doors, provide blocking as needed to eliminate through-bolting hardware. For mineral-core doors use composite blocking with improved screw-holding capability.
- E. Provide doors with either glued-block or structural composite lumber cores instead of particleboard cores at locations where exit devices are indicated.

2.3 FABRICATION

- A. Fabricate doors in sizes indicated for Project-site fitting.
- B. Factory machine doors for hardware that is not surface applied.
1. Comply with requirements in NFPA 80 for fire-rated doors.
 2. Metal Astragals: Premachine astragals and formed-steel edges for hardware for pairs of fire-rated doors.
- C. Openings: Cut and trim openings through doors to comply with applicable requirements of referenced standards for kind(s) of door(s) required.
- D. Provide pre-machine metal overlapping astragals to inactive door leaf and at double egress door as required. Refer to Division 8 Section "Door Hardware."

2.4 FACTORY FINISHING

- A. General: Finish wood doors at factory.
- B. Grade: Premium.
- C. Finish: Manufacturer's standard finish with performance comparable to AWI System TR-6 catalyzed polyurethane.
- D. Staining: To be selected by Architect from Manufacturer's full range.
- E. Effect: Open-grain finish.
- F. Sheen: Satin.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install doors to comply with manufacturer's written instructions, referenced quality standard, and as indicated.
 - 1. Install fire-rated doors in corresponding fire-rated frames according to NFPA 80.
- B. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal cut surfaces after fitting and machining.
 - 1. Comply with NFPA 80 for fire-rated doors.
- C. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.
- D. Hardware: For installation, see Division 8 Section "Door Hardware."

3.2 ADJUSTING AND PROTECTING

- A. Operation: Rehang or replace doors that do not swing or operate freely.
- B. Finished Doors: Refinish or replace doors damaged during installation.
- C. Protect doors as recommended by door manufacturer to ensure that wood doors are without damage or deterioration at the time of Substantial Completion.

END OF SECTION 081416

SECTION 083100 - ACCESS DOORS AND FRAMES

PART 1: GENERAL

1.1 RELATED DOCUMENTS

Drawings and general provisions of the contract, including supplementary conditions and Division 1 specification sections, apply to this section.

1.2 SUMMARY

Access Doors and Frames includes access panels and frames for the following types of installations:

- A. Wall access panels and frames
- B. Ceiling access panels and frames

1.3 RELATED SECTIONS:

Applicable related specification sections:

- A. Section 061053 - Miscellaneous Rough Carpentry
- B. Section 087100 - Door Hardware (for mortise cylinder lock)
- C. Section 092116 - Gypsum Board Assemblies.

1.4 SUBMITTALS

- A. General: In accordance with conditions of Division 1 specifications
- B. Manufacturer's submittals documents and installation instructions.

1.5 QUALITY ASSURANCE

- A. So there shall be no division of responsibility, all access panels shall be supplied by a single manufacturer under a single contract.
- B. Obtain design professional's approval for all panel sizes that vary from the general dimensions listed in these specifications, if they are not in accordance with manufacturer's standards.

1.6 COORDINATION & RESPONSIBILITY FOR ACCESS PANELS & AIR RETURN GRILLES ON SITE

- A. Determine specific locations and sizes for access panels needed to gain access to concealed equipment & indicate on schedule specified under "submittals" article.

- B. Access panels to gain access to equipment specified in Division 15 & 16 and where panels are not shown on drawings are to be provided by the applicable subcontractor and in compliance with requirements listed in these sections.
- C. Determine specific locations and sizes for air return grilles (access panels) needed to provide return air flow and to gain access to concealed equipment & indicate on schedule specified under "submittals" article.
- D. Air return grilles to provide ventilation and access to equipment specified in Divisions 21, 22, 23, 24, 25, 26, 27 & 28. Grilles not shown on drawings are to be provided by the applicable subcontractor and in compliance with requirements listed in these sections.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Package and ship in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
- B. Store indoors in a dry area out of direct sunlight in compliance to manufacturer's instructions.
- C. Protect materials and finishes from damage during handling and installation.

1.8 WARRANTY

- A. Warranty:
 - 1 year warranty for defective items from manufacturing workmanship or materials. Warranty commences as of the date of the completion of the sale, or the date the owners take possession; whichever is sooner.

PART 2: PRODUCTS

2.1 MANUFACTURER / DISTRIBUTOR

- A. BAUCO Access Panel Solutions, Inc.
- B. Substitutions: Submit per section 012500

2.2 ACCESS DOORS AND FRAMES

- A. Virtually Invisible Front-Mounting Recessed Drywall Access Panels
 - Products:
 - BAUCO XL
 - Description: Heavy-duty non-fire rated recessed access doors with concealed hardware and gypsum board inlay for flush installation and virtually invisible finish. Install on the front of surrounding wallboard.
 - Features:

- 2.8mm thick aluminum inner and outer frame
- Front-mounting aluminum frame provides solidly integrated finishing bead to prevent damage and to ensure a straight smooth finish. Countersunk holes to receive fastener heads
- Factory-installed, screwed-in-place gypsum board (or equivalent) door leaf inlay, to match surrounding wall or ceiling surface
- Galvanized steel internal corner reinforcing
- Panel frame edge raised in a 0.5mm to accept finishing compound for a flush frame finish.
- Concealed hinge made of heavy-duty, galvanized steel components with variable pivot point in double track to allow all doors to open 105 degrees
- Nylon-coated wire braid safety cable, test rated for 135lb (61kg), with crimp connections and spring snap aluminum carabineer
- Lift-out door leaf for fully clear access opening
- Closed-cell foam-filled rubber gasket to maintain STC rating of surrounding wall or ceiling assembly
- Aluminum tube or steel U-channel reinforcing on back of door leaves
- Large doors provided in multi-leaf formats with no bar between leaves
- Material Overview:
 - Extruded aluminum alloy 6063-T6 frames, supports, and bracing with at least 25% post-industrial recycled content by weight
 - Moisture- and mold-resistant gypsum board inlay with at least 21% post-consumer recycled content by weight
 - Galvanized internal steel hardware with at least 50% post-industrial recycled content by weight
 - Closed-cell foam-filled rubber gaskets
- Inlay: Standard moisture and mold-resistant gypsum board. Access panel inlay shall equal surrounding substrate specifications to ensure acoustic integrity and flush finish.
- Location: Wall
- Assembly thickness: Face-mounting 5/8" (15.9mm) thick access door sits flush with wall or ceiling assemblies of any thickness.
- Opening size: As indicated in Drawings.
- Factory finish: [Unfinished door leaf] [BAUCO Paint Ready option]
- Latch: Concealed mechanical touch latches and keyed-alike cylinder lock.

- Framing: For a proper fit the rough framed opening will be 1 1/4" greater than clear opening size. This additional 1 1/4" provides for two times the door frame size thickness plus 1/16" allowance on all sides of the panel.
- Finish: Installers shall apply the same finish and paint to door leaf as the surrounding surfaces. When installed and finished the access panel shall be flush with the wall or ceiling surface and only a 5/64" (2 mm) perimeter gap shall be visible. BAUCO XL access panels require finishing using common trade tools. For best results a setting-type gypsum finishing compound is recommended. Apply compound separately to the door leaf up to trim leading edge and to the finishing bead along the door frame.

B. Flush Sheet-Metal Access Panels:

- Products:
 - BAUCO Softline
- Description: Non-fire rated flush sheet-metal access doors with soft transition frames for wall or ceiling
- Features:
 - 20 gauge galvanized sheet metal door and frame
 - Visible, low profile flange frame only 1.8 mm above finished wall or ceiling surface, with soft transition frame edge and no visible joints or welds
 - Concealed pin hinge, reversible for right- or left-hand hinging
 - Fully removable door
 - 4 concealed adjustable wall anchor tabs with prepunched holes for fasteners
- Material Overview:
 - Galvanized steel hardware
- Latch: Concealed mechanical touch latches - Standard with T handle.
- Location: Ceiling
- Opening size: As indicated in Drawings.
- Framing: For a proper fit, the rough framed opening will be 1/4" greater than product code sizing.
- Finish: Powder coat painted white (RAL 9016).

2.3 FABRICATION

- A. Manufacture each access panel and grille assembly as an integral unit ready for site installation.
- B. Furnish number of latches required to hold door or grille flush for a smooth uniform panel appearance when closed.
- C. Larger sizes bracing will be added to add rigidity and/or prevent sagging.
- D. Supply rear of panel door with acoustic treatment when specified.
- E. Provide installation instructions with each panel and grille.
- F. Rear of panel door leaf label indicating product model and size.

PART 3: EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive access doors or grilles. Notify Architect if areas are not acceptable. Do not begin installation until unacceptable conditions have been corrected.

3.2 PREPARATION

- A. Advise installers of work relating to access panel installation including rough opening dimensions, locations of supports, and anchoring methods. Coordinate delivery with other work to avoid delay.

3.3 INSTALLATION

- A. Follow manufacturer's instructions for installing access panels. Install access doors plumb, level, and square.
- B. Anchor frames securely in place.
- C. Set frames to proper alignment with the wall or ceiling.
- D. Position access panels for proper access to concealed equipment requiring access.

3.4 ADJUST AND CLEAN

- A. Adjust panel after installation for proper operation. Remove drywall compound from hinge, frame and door leaf edge. Clean the frame and door with a damp cloth.
- B. Remove and replace panels or frames that are warped, bowed, or damaged.
- C. Warranty:

NEW CONSTRUCTION FOR:
DOW GARDENS WELCOME CENTER
MIDLAND, MICHIGAN

PROJECT NO. 2022022

BAUCO Access Panel Solutions Incorporated, as the manufacturer of BAUCO brand access panels for drywall, hereby warrants that the all access panels supplied are free of manufacturing defects.

We do not install the materials (access panels) on site and do not warrant the installation or workmanship provided by the contractor on site.

Further, we agree to supply replacement panels or components for any access panels or components, which may prove to be defective in manufacturing workmanship or materials within a period of 1 year, ordinary wear and tear and faulty installation excepted. Warranty commences as of the date of the completion of the sale, or the date the owners take possession; whichever is sooner.

END OF SECTION

SECTION 08 34 00 - SPECIAL FUNCTION DOORS

2.1 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 Aluminum-Framed Top-Hung Sliding Doors
- B. Related Sections:
 - 1. Section 08 14 16 - Flush Wood Doors

1.3 REFERENCES

- A. ANSI - American National Standards Institute
 - 1. ANSI 156.18 Materials and Finishes
 - 2. ANSI A117.1 Specifications for making buildings and facilities usable by physically handicapped people.
- B. BHMA - Builders Hardware Manufacturers Association
- C. DHI - Door and Hardware Institute
- D. NFPA - National Fire Protection Association
 - 1. NFPA 80 - Fire Doors and Windows
 - 2. NFPA 101 - Life Safety code
 - 3. NFPA 105 - Smoke and Draft Control Door Assemblies
 - 4. NFPA 252 - Fire Tests of Doors Assemblies
- E. AWS - Architectural Woodwork Standards

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's product data, including installation instructions.

- B. Shop Drawings: Submit manufacturer's shop drawings, including plans, elevations, sections, and details, indicating dimensions, tolerances, materials, components, hardware, finish, options, and accessories. Shop Drawings to show required blocking by others.
- C. Samples: Submit manufacturer's samples of the following sliding door components:
 - 1. Door veneer or laminate sample.
- D. Manufacturer's Certification: Submit manufacturer's certification that materials comply with specified requirements and are suitable for intended application.
- E. Warranty Documentation: Submit manufacturer's standard warranty.
- F. Test Reports: Submit acoustical reports or UL1784 as applicable.

1.5 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of interior aluminum frames and doors.
- B. Source: Obtain sliding aluminum framed doors and hardware from single source.
- C. Manufacturer's Qualifications: Manufacturer regularly engaged for past 5 years in manufacture of sliding doors similar to that specified.

1.6 PERFORMANCE

- A. Aluminum perimeter frames with integral acoustic seals at all door/frame interfaces
 - 1. Architect to verify frame thickness suitable for required application
- B. Soft-closing mechanism at both sides of door integrated with top track. Soft Closers tested to a minimum of 150,000 cycles.
- C. Concealed door guide.
- D. Manufacturer to 3rd party acoustical performance test data
- E. Manufacturer to submit 3rd party test data on air infiltration and/or smoke ratings as applicable

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Delivery and Acceptance Requirements: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.

- B. Notify manufacturer immediately of any shipping damage.
- C. Storage and Handling Requirements:
 - 1. Store and handle materials in accordance with manufacturer's instructions.
 - 2. Keep materials in manufacturer's original, unopened containers and packaging until installation.
 - 3. Store materials in clean, dry area indoors.
 - 4. Protect materials and finish during storage, handling, and installation to prevent damage.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- 1. AD SYSTEMS 2201 100th St. SW, Everett, WA 98204 | Website: <http://specADsystems.com> | Phone: 425-740-6011 | ADSystems.Estimating@allegion.com

2.2 INTERIOR SLIDING ALUMINUM-FRAMED DOORS AND PARTITIONS

- 1. Manufacturer:
 - a. Scheduled Manufacturer: OfficeSlide™ High Performance Barn (Sliding) Door System by AD Systems.
 - b. Acceptable Substitute: See Section 01 2500 - Substitution Procedures..
- 2. Specified Wall Thickness: 4-7/8"
- 3. Frame Profiles: Extruded aluminum frame "wrap" frame with integral vertical jamb (stile pocket).
- 4. Finish:
 - a. Standard: Painted Hardcoat (Kynar) Finish. Meets AAMA 2604 Standard Colors: As selected from manufacturer full line.
- 5. Frame Profiles: Extruded aluminum frame "wrap" frame with integral vertical jamb (stile pocket).
 - a. Profile Dimensions:
 - 1) Standard Depth (IM-01) Mullion and Sill
 - 2) Vertical Mullions (if applicable): vertical frames at joints
- 6. Door Leaves: all Doors to be factory machined for hardware including pilot and function holes.

- a. 1-3/4" Flush Wood Door: Reference Spec Section 08 14 16 Wood Doors or other section as applicable.
 - 1) Optional Glazing: safety laminated glass with frosted vinyl film per section 088000
 - 2) Standard stile widths are 6" with a 10" bottom rail.
7. Door Components:
 - a. Single Top Track: AD Systems extruded aluminum track by AD Systems
 - b. Valances: Extruded aluminum with integral end caps
 - c. Top Rollers: tandem nylon roller sized to match door weight.
 - d. Concealed Floor Guide: Integral Jamb floor guide by AD Systems.
 - e. Soft-Closers: Soft-closing dampener mechanism at both sides of door leaf. Demonstrate closers as tested to 150k cycles.
8. Door Locks (Optional):
 - a. Self-Latching Lock with Single Action Egress (Standard: return to door tubular lever. Other Lever Options: Contact AD Systems)
 - 1) Finish: US 32D Standard, other finishes available contact AD Systems
 - 2) AD6450 Office—Keyed lock with Cylinder/ADA compliant thumbturn and back to back lever trim.
9. Self-Closing Spring Mechanism
10. Automatic Door Bottom for improved acoustical performance

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine wall openings to receive sliding doors for plumb, level, and square. Note: Finish door operation will be affected by out of tolerance framing.
- B. Verify dimensions of wall openings.
- C. Examine surfaces to receive top and bottom guide.
- D. Notify Architect of conditions that would adversely affect installation or subsequent use of sliding doors.
- E. Do not begin installation until unacceptable conditions are corrected.
- F. Base of door side to be flush or minimal. Rubber Base acceptable.

3.2 INSTALLATION

- A. Install sliding doors in accordance with manufacturer's instructions at locations indicated on the Drawings.
- B. Install sliding doors plumb, level, square, and in proper alignment.
- C. Install sliding doors to close against walls without gaps.
- D. Install sliding doors to open and close smoothly.
- E. Anchor sliding doors securely in place to supports. Required: Fire treated 2 x 6 blocking required full length of track.

3.3 ADJUSTING

- A. Adjust sliding doors for proper operation in accordance with manufacturer's instructions.
- B. Adjust sliding doors to operate smoothly without binding.
- C. Repair minor damages to finish in accordance with manufacturer's instructions and as approved by Architect.

3.4 CLEANING

- A. Clean sliding doors promptly after installation in accordance with manufacturer's instructions.
- B. Do not use harsh cleaning materials or methods that could damage materials or finish.

3.5 PROTECTION

- A. Protect installed sliding doors from damage during construction.

END OF SECTION - 083400

SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Storefront framing.
 - 2. Manual-swing entrance doors.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For aluminum-framed entrances and storefronts. Include plans, elevations, sections, full-size details, and attachments to other work.
 - 1. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
 - 2. Include point-to-point wiring diagrams.
- C. Samples: For each type of exposed finish required.
- D. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication, and assembly of entrance door hardware, as well as procedures and diagrams.
- E. Delegated-Design Submittal: For aluminum-framed entrances and storefronts indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.3 INFORMATIONAL SUBMITTALS

- A. Energy Performance Certificates: NFRC-certified energy performance values from manufacturer.
- B. Product test reports.
- C. Source quality-control reports.
- D. Field quality-control reports.
- E. Sample warranties.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated.
- C. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
 - 1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

1.6 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of aluminum-framed entrances and storefronts that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.
- B. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design aluminum-framed entrances and storefronts.
- B. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrances and storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
 - 1. Aluminum-framed entrances and storefronts shall withstand movements of supporting structure, including, but not limited to, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
 - 2. Failure also includes the following:
 - a. Thermal stresses transferring to building structure.
 - b. Glass breakage.
 - c. Noise or vibration created by wind and thermal and structural movements.
 - d. Loosening or weakening of fasteners, attachments, and other components.
 - e. Failure of operating units.
- C. Structural Loads:
 - 1. Wind Loads: per Michigan Building Code.
 - 2. Other Design Loads: per Michigan Building Code.
- D. Deflection of Framing Members: At design wind pressure, as follows:
 - 1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans of up to 13 feet 6 inches (4.1 m) and to 1/240 of clear span plus 1/4 inch (6.35 mm) for spans greater than 13 feet 6 inches (4.1 m) or an amount that restricts edge deflection of individual glazing lites to 3/4 inch (19.1 mm), whichever is less.
 - 2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch (3.2 mm), whichever is smaller.
 - a. Operable Units: Provide a minimum 1/16-inch (1.6-mm) clearance between framing members and operable units.
 - 3. Cantilever Deflection: Where framing members overhang an anchor point, as follows:
 - a. Perpendicular to Plane of Wall: No greater than 1/240 of clear span plus 1/4 inch (6.35 mm) for spans greater than 11 feet 8-1/4 inches (3.6 m) or 1/175 times span, for spans of less than 11 feet 8-1/4 inches (3.6 m).
- E. Structural: Test according to ASTM E 330/E 330M as follows:
 - 1. When tested at positive and negative wind-load design pressures, storefront assemblies, including entrance doors, do not evidence deflection exceeding specified limits.
 - 2. When tested at 150 percent of positive and negative wind-load design pressures, storefront assemblies, including entrance doors and anchorage, do not evidence

- material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Durations: As required by design wind velocity, but not less than 10 seconds.
- F. Air Infiltration: Test according to ASTM E 283 for infiltration as follows:
1. Fixed Framing and Glass Area:
 - a. Maximum air leakage of 0.06 cfm/sq. ft. (0.30 L/s per sq. m) at a static-air-pressure differential of 6.24 lbf/sq. ft. (300 Pa).
 2. Entrance Doors:
 - a. Single Doors: Maximum air leakage of 0.5 cfm/sq. ft. (2.54 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).
- G. Water Penetration under Static Pressure: Test according to ASTM E 331 as follows:
1. No evidence of water penetration through fixed glazing and framing areas, including entrance doors, when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa).
- H. Energy Performance: Certify and label energy performance according to NFRC as follows:
1. Thermal Transmittance (U-factor): Fixed glazing and framing areas as a system shall have U-factor of not more than 0.45 Btu/sq. ft. x h x deg F (2.55 W/sq. m x K) as determined according to NFRC 100.
 2. Condensation Resistance: Fixed glazing and framing areas as a system shall have an NFRC-certified condensation resistance rating of no less than 45 as determined according to NFRC 500.
- I. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes.
1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 STOREFRONT SYSTEMS

- A. Basis-of-Design Product for Aluminum-Framed Entrances and Storefronts: Subject to compliance with requirements, provide KAWNEER 450 series for interior, and KAWNEER 451T series for exterior. Substitutions: See Section 012500 - Product Requirements.
- B.
- C. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.
1. Exterior Framing Construction: Thermally broken.
 2. Interior Vestibule Framing Construction: Nonthermal.
 3. Glazing System: Retained mechanically with gaskets on four sides.
 4. Finish: Clear anodic finish and baked-enamel.
 5. Fabrication Method: Field-fabricated stick system.
 6. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 7. Steel Reinforcement: As required by manufacturer.
- D. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.
- E. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with non-staining, nonferrous shims for aligning system components.

2.3 ENTRANCE DOOR SYSTEMS

- A. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing or automatic operation.

1. Door Construction: 1-3/4-inch (44.5-mm) overall thickness, with minimum 0.125-inch (3.2-mm-) thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
 - a. Thermal Construction: High-performance plastic connectors separate aluminum members exposed to the exterior from members exposed to the interior.
2. Door Design: Wide stile; 5-inch (127-mm) nominal width.
3. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and preformed gaskets.
 - a. Provide nonremovable glazing stops on outside of door.

2.4 ENTRANCE DOOR HARDWARE

- A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 087100 "Door Hardware."

2.5 INTERIOR STOREFRONT SYSTEMS

- A. A. Basis-of-Design Product: Subject to compliance with requirements, provide Avanti Systems, Inc.; Solare™ acoustic, single-glazed partition system or comparable product by one of the following:
 1. DORMA USA, Inc.
 2. Nana Wall Systems, Inc.
- B. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.
 1. Interior Vestibule Framing Construction: Nonthermal.
 2. Glazing System: Retained mechanically with gaskets on four sides.
 3. Glazing Plane: Center.
 4. Finish: Clear anodic.
 5. Fabrication Method: Field-fabricated stick system.
 6. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 7. Steel Reinforcement: As required by manufacturer.
- C. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.
- D. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

2.6 GLAZING

- A. Glazing: Comply with Section 088000 "Glazing."
- B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.
- C. Glazing Sealants: As recommended by manufacturer.

2.7 MATERIALS

- A. Sheet and Plate: ASTM B 209 (ASTM B 209M).
- B. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221 (ASTM B 221M).

- C. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.
- D. Structural Profiles: ASTM B 308/B 308M.
- E. Steel Reinforcement:
 - 1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
 - 2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
 - 3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.
 - 4. Primer: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM, and prepare surfaces according to applicable SSPC standard.

2.8 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Weld in concealed locations to the greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Fabricate components that, when assembled, have the following characteristics:
 - 1. Profiles that are sharp, straight, and free of defects or deformations.
 - 2. Accurately fitted joints with ends coped or mitered.
 - 3. Physical and thermal isolation of glazing from framing members.
 - 4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 - 5. Provisions for field replacement of glazing from interior.
 - 6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
- E. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
- F. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
- G. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.
- H. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.9 ALUMINUM FINISHES

- A. Dark Bronze Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General:
 - 1. Comply with manufacturer's written instructions.
 - 2. Do not install damaged components.
 - 3. Fit joints to produce hairline joints free of burrs and distortion.
 - 4. Rigidly secure nonmovement joints.
 - 5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
 - 6. Seal perimeter and other joints watertight unless otherwise indicated.

- B. Metal Protection:
 - 1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
 - 2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- C. Set continuous sill members and flashing in full sealant bed, as specified in Section 079200 "Joint Sealants," to produce weathertight installation.
- D. Install components plumb and true in alignment with established lines and grades.
- E. Install operable units' level and plumb, securely anchored, and without distortion. Adjust weather-stripping contact and hardware movement to produce proper operation.
- F. Install glazing as specified in Section 088000 "Glazing."
- G. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.
 - 1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
 - 2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

3.2 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Field Quality-Control Testing: Perform the following test on representative areas of aluminum-framed entrances and storefronts.
 - 1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.
 - a. Test Area: A minimum area of 75 feet (23 m) by 1 story of aluminum-framed systems.
 - 2. Air Infiltration: ASTM E 783 at 1.5 times the rate specified for laboratory testing in "Performance Requirements" Article but not more than 0.09 cfm/sq. ft. (0.45 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).
 - 3. Water Penetration: ASTM E 1105 at a minimum uniform and cyclic static-air-pressure differential of 0.67 times the static-air-pressure differential specified for laboratory testing in "Performance Requirements" Article, but not less than 6.24 lbf/sq. ft. (300 Pa), and shall not evidence water penetration.
- C. Aluminum-framed entrances and storefronts will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

END OF SECTION 084113

SECTION 084413: GLAZED ALUMINUM CURTAIN WALLS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section covers Kawneer Architectural Aluminum Curtain Wall Systems, including perimeter trims, stools, accessories, shims and anchors, and perimeter sealing of curtain wall framing.
- B. Types of Kawneer Aluminum Curtain Wall Systems include:
 - 1. 1620OUT Curtain Wall System with 1" (25.4 mm) double-glazed insulating glass
 - a. Sightline: 2" (50.8 mm)
 - b. System depth: 6" (152.4 mm) or 7-1/2" (190.5 mm)
 - c. Outside-glazed pressure plate format
- C. Related Sections:
 - 1. 079200: Joint Sealants
 - 2. 084113: Aluminum-Framed Entrances and Storefronts
 - 3. 084313: Aluminum-Framed Storefronts
 - 4. 088000: Glazing

1.3 DEFINITIONS

- A. For fenestration industry standard terminology and definitions, refer to the Fenestration & Glazing Industry Alliance (FGIA) Glossary (AAMA AG-13).

1.4 PERFORMANCE REQUIREMENTS

- A. General Performance:
 - 1. Product to comply with the specified performance requirements without failure due to defective manufacture, fabrication, installation, or other defects in construction, as determined by testing of glazed aluminum curtain walls representing those indicated for this project.
 - 2. Glazed aluminum curtain walls 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.
 - 3. Failure includes any of these events:
 - a. Thermal stresses transferring to building structure
 - b. Glass breakage
 - c. Loosening or weakening of fasteners, attachments, and other components

- d. Failure of operating units
- B. Delegated Design:
 1. Design glazed aluminum curtain walls, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- C. Wind Loads:
 1. The design pressures are based on the Michigan Building Code, 2015 Edition.
- D. Air Leakage:
 1. The test specimen shall be tested in accordance with ASTM E 283.
 2. Air infiltration rate shall not exceed 0.06 cfm/ft² (0.3 l/s · m²) at a static air pressure differential of 6.2 psf (300 Pa).
- E. Water Resistance:
 1. Static:
 - a. The test specimen shall be tested in accordance with ASTM E 331.
 - b. There shall be no leakage at a minimum static air pressure differential of 20 psf (960 Pa) as defined in AAMA 501.
 2. Cyclic:
 - a. The test specimen shall be tested in accordance with ASTM E 547.
 - b. There shall be no leakage at an air pressure differential of 20 psf (960 Pa) as defined in AAMA 501.
 3. Severe, Wind Driven Rain:
 - a. The test specimen shall be tested in accordance with AAMA 520 and ASTM E 2268.
 - b. There shall be no visible water at performance level 10, pressure limits 14 psf (670 Pa) to 42 psf (2010 Pa).
- F. Uniform Load:
 1. A static air design load of 42 psf (2010 Pa) shall be applied in the positive and negative direction in accordance with ASTM E 330.
 2. There shall be no deflection in excess of L/175 of the span of any framing member at design load.
 3. At a structural test load equal to 1.5 times the specified design load, no glass breakage or permanent set in the framing members in excess of 0.2% of their clear spans shall occur.
- G. Thermal Movements:
 1. Allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures:
 - a. Temperature Change (Range): 0 °F (-18 °C); 180 °F (82 °C).
 - b. Test Interior Ambient Air Temperature: 75 °F (24 °C).

- c. Test Performance: 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 for a minimum 3 cycles.
- H. Seismic:
1. When tested to AAMA 501.4, system must meet design displacement (elastic) of 0.010 times the story height and ultimate displacement (inelastic) of 1.5 times the design displacement.
 2. When tested to AAMA 501.6, system must meet dynamic seismic drift causing glass cracking (Δ Cracking) of 3" or 0.0300 times the story height, and glass fallout (Δ Fallout) of 5" or 0.0500 times the story height.
- I. Thermal Transmittance (U-factor), Physical Test:
1. Thermal transmittance test results in accordance with AAMA 1503 are based upon argon-filled 1" (25.4 mm) or 1-3/4" (44.4 mm) clear low-emissivity coated glass with warm edge spacer.
 2. For 1" (25.4 mm) low-emissivity coated glass: When tested using AAMA 1503, the thermal transmittance (U-factor) shall not be more than 0.35 Btu/(hr·ft²·°F).
- J. Thermal Transmittance (U-factor), Simulation:
1. Thermal transmittance simulation results using NFRC 100 or AAMA 507 are based upon argon-filled 1" (25.4 mm) or 1-3/4" (44.4 mm) clear low-emissivity coated glass with warm edge spacer.
 2. For 1" (25.4 mm) glass with Center of Glass (COG) U-factor of 0.24 Btu/(hr·ft²·°F) and warm edge spacer, when simulated using NFRC 100 or AAMA 507, the thermal transmittance (U-factor) shall not be more than 0.32 Btu/(hr·ft²·°F) or project specific (____) Btu/(hr·ft²·°F) per AAMA 507 or (____) Btu/(hr·ft²·°F) per NFRC 100.
- K. Condensation Resistance Factor (CRF):
1. Condensation resistance test results in accordance with AAMA 1503 are based upon argon-filled 1" (25.4 mm) or 1-3/4" (44.4 mm) clear low-emissivity coated glass with warm edge spacer.
 2. For 1" (25.4 mm) glass: When tested using AAMA 1503, the CRF_{frame} and CRF_{glass} shall not be less than 77 and 71 respectively.
- L. Temperature Index (I):
1. For 1" (25.4 mm) double glazed low-emissivity coated glass: when tested to CSA-A440-00, the TI_{frame} and TI_{glass} shall not be less than 69 and 65 respectively.
- M. Sound Transmission Loss:
1. When tested to ASTM E90 and ASTM E1425, the Sound Transmission Class (STC) and Outdoor/Indoor Transmission Class (OITC) shall not be less than:
 - a. STC 34 or OITC 29 based upon 1" (25.4 mm) laminated glass (1/4", 1/2" AS, 1/4" laminated)
 - b. STC 33 or OITC 27 based upon 1-3/4" (44.4 mm) glass (1/4", 1/2" AS, 1/4", 1/2" AS, 1/4")

A. Product Data:

1. For each type of product indicated, include:
 - a. Construction details
 - b. Material descriptions
 - c. Dimensions of individual components and profiles
 - d. Finishes

B. Shop Drawings:

1. Plans
2. Elevations
3. Sections
4. Full-size details
5. Attachments to other work

C. Samples for Initial Selection:

1. Provide samples for units with factory-applied color finishes.

D. Samples for Verification:

1. Provide a verification sample for each type of exposed finish required, in manufacturer's standard sizes.

E. Product Test Reports:

1. Provide test reports for glazed aluminum curtain walls.
2. Test reports must be based on evaluation of comprehensive tests performed by a qualified preconstruction testing agency.
3. Test reports must indicate compliance with performance requirements.

F. Fabrication Sample:

1. Provide a fabrication sample of each vertical-to-horizontal intersection of aluminum-framed curtain wall systems, made from 12" (304.8 mm) lengths of full-size components and showing details of the following:
 - a. Joinery
 - b. Glazing

1.6 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer must have successfully installed the same or similar systems required for the project and other projects of similar size and scope.

B. Manufacturer Qualifications:

1. Manufacturer must be capable of fabricating glazed aluminum curtain walls that meet or exceed the stated performance requirements.

C. Source Limitations:

1. Obtain aluminum curtain wall system through one source from a single manufacturer.

D. Product Options:

1. 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.
2. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

E. Mockups:

1. Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
2. Build mockups for the type(s) of curtain wall elevation(s) indicated, in location(s) shown on drawings.

F. Pre-installation Conference:

1. Conduct conference at project site to comply with requirements in Division 01 Project Management and Coordination Section.

1.7 PROJECT CONDITIONS

A. Field Measurements:

1. Verify actual locations of structural supports for glazed aluminum curtain walls by field measurements before fabrication.
2. Indicate measurements on shop drawings.

1.8 WARRANTY

A. Submit manufacturer's standard warranty for owner's acceptance.

B. Warranty Period:

1. Two years from Date of Substantial Completion of the project provided however that in no event shall the Limited Warranty begin later than six months from date of shipment by manufacturer.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product:

1. Kawneer Company, Inc.
2. 1620UT Curtain Wall System types:
 - a. 1620UT Curtain Wall System with 1" (25.4 mm) double-glazed insulating glass

- 1) Sightline: 2" (50.8 mm)
 - 2) System depth: 6" (152.4 mm) or 7-1/2" (190.5 mm)
 - 3) Outside-glazed pressure plate format
3. Test to AAMA 501-04 and AAMA 501-06.

B. Substitutions:

1. Refer to Division 01 Substitutions Section for procedures and submission requirements.
2. Pre-Contract (Bidding Period) Substitutions:
 - a. Submit written requests ten (10) days prior to bid date.
3. Post-Contract (Construction Period) Substitutions:
 - a. Submit written request in order to avoid installation and construction delays.
4. Product Literature and Drawings:
 - a. Submit product literature and drawings modified to suit specific project requirements and job conditions.
5. Certificates:
 - a. Submit certificate(s) certifying that the substitute manufacturer (1) attests to adherence to specification requirements for curtain wall system performance criteria, and (2) has been engaged in the design, manufacture, and fabrication of aluminum curtain walls for a period of not less than ten (10) years. (*Company Name*).
6. Test Reports:
 - a. Submit test reports verifying compliance with each test requirement required by the project.
7. Samples:
 - a. Provide samples of typical product sections and finish samples in manufacturer's standard sizes.

C. Substitution Acceptance:

1. Acceptance will be in written form, either as an addendum or modification.
2. Acceptance will be documented by a formal change order signed by the owner and contractor.

2.2 MATERIALS

A. Aluminum Extrusions:

1. Alloy and temper recommended by glazed aluminum curtain wall manufacturer for strength, corrosion resistance, and application of required finish
2. Not less than 0.070" (1.8 mm) wall thickness at any location for the main frame
3. Complying with ASTM B221: 6063-T6 alloy and temper

B. Aluminum Sheet Alloy:

1. Shall meet the requirements of ASTM B209.

C. Fasteners:

1. Aluminum, nonmagnetic stainless steel or other materials must be non-corrosive and compatible with aluminum members, trim hardware, anchors, and other components.

D. Anchors, Clips, and Accessories:

1. Aluminum, nonmagnetic stainless steel, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions or other suitable zinc coating.
2. Anchors, clips, and accessories shall provide sufficient strength to withstand the design pressure indicated.

E. Pressure Plate:

1. Pressure plate shall be aluminum.
2. Pressure plate shall be fastened to the mullion with stainless steel screws.

F. Reinforcing Members:

1. Aluminum, nonmagnetic stainless steel, or nickel/chrome-plated steel complying with ASTM B 456 for Type SC 3 severe service conditions, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions or other suitable zinc coating.
2. Reinforcing members must provide sufficient strength to withstand the design pressure indicated.

G. Sealant:

1. For sealants required within fabricated curtain wall system, provide permanently elastic, non-shrinking, and non-migrating type recommended by sealant manufacturer for joint size and movement.

H. Thermal Barrier:

1. Thermal separator shall be extruded of a silicone compatible elastomer that provides a minimum 1/4" (6.3 mm) separation.

I. Tolerances:

1. References to tolerances for wall thickness and other cross-sectional dimensions of glazed curtain wall members are nominal and in compliance with AA Aluminum Standards and Data.

2.3 CURTAIN WALL FRAMING

A. Framing Members:

1. Manufacturer's standard extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads
2. Glazing System: Four-sided captured
3. Glazing Plane: Front

B. Glass:

1. 1" (25.4 mm) and 1-3/4" (44.4 mm) insulating glass option

2. 1/4" (6.4 mm) for spandrel applications

C. Brackets and Reinforcements:

1. Manufacturer's standard high-strength aluminum with non-staining, non-ferrous shims for aligning system components.

D. Framing Sealants:

1. Shall be suitable for glazed aluminum curtain wall as recommended by sealant manufacturer.

E. Fasteners and Accessories:

1. Manufacturer's standard corrosion-resistant, non-staining, non-bleeding fasteners and accessories must be compatible with adjacent materials.
2. Where exposed, fasteners and accessories shall be stainless steel.

F. Perimeter Anchors:

1. When steel anchors are used, provide insulation between steel material and aluminum material to prevent galvanic action.

G. Packing, Shipping, Handling, and Unloading:

1. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

H. Storage and Protection:

1. Store materials so that they are protected from exposure to harmful weather conditions.
2. Handle material and components to avoid damage.
3. Protect material against damage from elements, construction activities, and other hazards before, during, and after installation.

2.4 GLAZING

A. Glazing to meet requirements in Division 08 Glazing Section.

B. Available Glazing Options:

1. Outside glazed pressure plate format with 1" (25.4 mm) double glazed and 1-3/4" (44.4 mm) triple glazed insulating glass.

C. Glazing Gaskets:

1. Gaskets to meet requirements of ASTM C864.

D. Spacers and Setting Blocks:

1. Manufacturer's standard elastomeric type

E. Bond-Breaker Tape:

1. Manufacturer's standard TFE-fluorocarbon or polyethylene material to which sealants will not develop adhesion.

F. Glazing Sealants:

1. As recommended by manufacturer for joint type.

2.5 OPERABLE UNITS

- A. Doors comply with Division 08 Aluminum-Framed Entrances and Storefronts Section.
- B. Windows comply with Division 08 Aluminum Windows Section.

2.6 ALUMINUM FINISHES

- A. Finish designations that are prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. Factory Finishing:
 1. Kawneer Permanodic® AA-M10C21A44, AAMA 611, Architectural Class I Color Anodic Coating (Color Dark Bronze)

PART 3 EXECUTION

3.1 EXAMINATION

- A. With installer present, examine areas for compliance with requirements for installation tolerances and other conditions affecting performance of the work.
- B. Proceed with installation only after correcting unsatisfactory conditions.

3.2 INSTALLATION

- A. Curtain Wall System Installation:
 1. Install curtain wall systems plumb, level, and true to line, without warp or rack of frames, within manufacturer's prescribed tolerances, and complying with installation instructions.
 2. Provide support and anchor in place.
 3. Dissimilar Materials:
 - a. Provide separation of aluminum materials from sources of corrosion or electrolytic action contact points.
 4. Glazing:
 - a. Glass shall be outside-glazed.
 - b. Glass shall be held in place with extruded aluminum pressure plates anchored to the mullion using stainless steel fasteners that are spaced no more than 9" (228.6 mm) on center.
 5. Water Drainage
 - a. Each light of glass shall be compartmentalized using joint plugs and silicone sealant to divert water to the horizontal weep locations.
 - b. Weep holes shall be located in the horizontal pressure plates and covers to divert water to the exterior of the building.

B. Related Products Installation:

1. Sealants (Perimeter):
 - a. Refer to Joint Treatment (Sealants) Section.
2. Glass:
 - a. Refer to Glass and Glazing Section.
 - b. Reference: ANSI Z97.1, CPSC 16 CFR 1201, and GANA Glazing Manual.

3.3 FIELD QUALITY CONTROL

A. Field Tests:

1. Architect shall select curtain wall units to be tested as soon as a representative portion of the project has been installed, glazed, perimeter-caulked, and cured.
2. Conduct tests for air infiltration and water penetration with manufacturer's representative present.
3. Tests that do not meet the specified performance requirements and units that have deficiencies shall be corrected as part of the contract amount.
4. Testing shall be performed per AAMA 503 by a qualified independent testing agency. Refer to Testing Section for payment of testing and testing requirements.
5. Air Infiltration Tests:
 - a. Conduct tests in accordance with ASTM E 783.
 - b. Allowable air infiltration shall not exceed 1.5 times the amount indicated in the performance requirements or 0.09 cfm/ft², whichever is greater.
6. Water Infiltration Tests:
 - a. Conduct tests in accordance with ASTM E 1105.
 - b. No uncontrolled water leakage is permitted when tested at a static test pressure of two-thirds the specified water penetration pressure but not less than 8 psf (383 Pa).

B. Manufacturer's Field Services:

1. Upon owner's written request, provide periodic site visit by manufacturer's field service representative.

3.4 ADJUSTING, CLEANING, AND PROTECTION

A. Adjusting: Not applicable.

B. Protection:

1. Protect installed product's finish surfaces from damage during construction.
2. Protect aluminum curtain wall system from damage from grinding and polishing compounds, plaster, lime, acid, cement, or other harmful contaminants.

C. Cleaning:

1. Repair or replace damaged installed products.
2. Clean installed products in accordance with manufacturer's instructions prior to owner's acceptance.

NEW CONSTRUCTION FOR:
DOW GARDENS WELCOME CENTER
MIDLAND, MICHIGAN

PROJECT NO. 2022022

3. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during the construction period.
4. Remove construction debris from project site and legally dispose of debris.

END OF SECTION 084413

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Mechanical and electrified door hardware
2. Electronic access control system components

B. Section excludes:

1. Windows
2. Cabinets (casework), including locks in cabinets
3. Signage
4. Toilet accessories
5. Overhead doors

C. Related Sections:

1. Division 01 "General Requirements" sections for Allowances, Alternates, Owner Furnished Contractor Installed, Project Management and Coordination.
2. Division 06 Section "Rough Carpentry"
3. Division 06 Section "Finish Carpentry"
4. Division 07 Section "Joint Sealants" for sealant requirements applicable to threshold installation specified in this section.
5. Division 08 Sections:
 - a. "Metal Doors and Frames"
 - b. "Flush Wood Doors"
 - c. "Stile and Rail Wood Doors"
 - d. "Interior Aluminum Doors and Frames"
 - e. "Aluminum-Framed Entrances and Storefronts"
 - f. "Stainless Steel Doors and Frames"
 - g. "Special Function Doors"
 - h. "Entrances"
6. Division 26 "Electrical" sections for connections to electrical power system and for low-voltage wiring.
7. Division 28 "Electronic Safety and Security" sections for coordination with other components of electronic access control system and fire alarm system.

1.02 REFERENCES

A. UL LLC

1. UL 10B - Fire Test of Door Assemblies
2. UL 10C - Positive Pressure Test of Fire Door Assemblies
3. UL 1784 - Air Leakage Tests of Door Assemblies
4. UL 305 - Panic Hardware

- B. DHI - Door and Hardware Institute
 - 1. Sequence and Format for the Hardware Schedule
 - 2. Recommended Locations for Builders Hardware
 - 3. Keying Systems and Nomenclature
 - 4. Installation Guide for Doors and Hardware

- C. NFPA - National Fire Protection Association
 - 1. NFPA 70 - National Electric Code
 - 2. NFPA 80 - 2016 Edition - Standard for Fire Doors and Other Opening Protectives
 - 3. NFPA 101 - Life Safety Code
 - 4. NFPA 105 - Smoke and Draft Control Door Assemblies
 - 5. NFPA 252 - Fire Tests of Door Assemblies

- D. ANSI - American National Standards Institute
 - 1. ANSI A117.1 - 2017 Edition - Accessible and Usable Buildings and Facilities
 - 2. ANSI/BHMA A156.1 - A156.29, and ANSI/BHMA A156.31 - Standards for Hardware and Specialties
 - 3. ANSI/BHMA A156.28 - Recommended Practices for Keying Systems
 - 4. ANSI/WDMA I.S. 1A - Interior Architectural Wood Flush Doors
 - 5. ANSI/SDI A250.8 - Standard Steel Doors and Frames

1.03 SUBMITTALS

- A. General:
 - 1. Submit in accordance with Conditions of Contract and Division 01 Submittal Procedures.
 - 2. Prior to forwarding submittal:
 - a. Review drawings and Sections from related trades to verify compatibility with specified hardware.
 - b. Highlight, encircle, or otherwise specifically identify on submittals: deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.

- B. Action Submittals:
 - 1. Product Data: Submit technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
 - 2. Riser and Wiring Diagrams: After final approval of hardware schedule, submit details of electrified door hardware, indicating:
 - a. Wiring Diagrams: For power, signal, and control wiring and including:
 - 1) Details of interface of electrified door hardware and building safety and security systems.
 - 2) Schematic diagram of systems that interface with electrified door hardware.
 - 3) Point-to-point wiring.
 - 4) Risers.

3. Samples for Verification: If requested by Architect, submit production sample of requested door hardware unit in finish indicated and tagged with full description for coordination with schedule.
 - a. Samples will be returned to supplier. Units that are acceptable to Architect may, after final check of operations, be incorporated into Work, within limitations of key coordination requirements.
4. Door Hardware Schedule:
 - a. Submit concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate fabrication of other work critical in Project construction schedule.
 - b. Submit under direct supervision of a Door Hardware Institute (DHI) certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule published by DHI.
 - c. Indicate complete designations of each item required for each opening, include:
 - 1) Door Index: door number, heading number, and Architect's hardware set number.
 - 2) Quantity, type, style, function, size, and finish of each hardware item.
 - 3) Name and manufacturer of each item.
 - 4) Fastenings and other pertinent information.
 - 5) Location of each hardware set cross-referenced to indications on Drawings.
 - 6) Explanation of all abbreviations, symbols, and codes contained in schedule.
 - 7) Mounting locations for hardware.
 - 8) Door and frame sizes and materials.
 - 9) Degree of door swing and handing.
 - 10) Operational Description of openings with electrified hardware covering egress, ingress (access), and fire/smoke alarm connections.
5. Key Schedule:
 - a. After Keying Conference, provide keying schedule that includes levels of keying, explanations of key system's function, key symbols used, and door numbers controlled.
 - b. Use ANSI/BHMA A156.28 "Recommended Practices for Keying Systems" as guideline for nomenclature, definitions, and approach for selecting optimal keying system.
 - c. Provide 3 copies of keying schedule for review prepared and detailed in accordance with referenced DHI publication. Include schematic keying diagram and index each key to unique door designations.
 - d. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.
 - e. Provide one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion. Forward bitting list, key cuts and key system schematic directly to Owner, by means as directed by Owner.
 - f. Prepare key schedule by or under supervision of supplier, detailing Owner's final keying instructions for locks.

C. Informational Submittals:

1. Provide Qualification Data for Supplier, Installer and Architectural Hardware Consultant.
 2. Provide Product Data:
 - a. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.
 - b. Include warranties for specified door hardware.
- D. Closeout Submittals:
1. Operations and Maintenance Data: Provide in accordance with Division 01 and include:
 - a. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
 - b. Catalog pages for each product.
 - c. Final approved hardware schedule edited to reflect conditions as installed.
 - d. Final keying schedule
 - e. Copy of warranties including appropriate reference numbers for manufacturers to identify project.
 - f. As-installed wiring diagrams for each opening connected to power, both low voltage and 110 volts.
- E. Inspection and Testing:
1. Submit written reports to the Owner and Authority Having Jurisdiction (AHJ) of the results of functional testing and inspection for:
 - a. Fire door assemblies, in compliance with NFPA 80.
 - b. Required egress door assemblies, in compliance with NFPA 101.

1.04 QUALITY ASSURANCE

- A. Qualifications and Responsibilities:
1. Supplier: Recognized architectural hardware supplier with a minimum of 5 years documented experience supplying both mechanical and electromechanical door hardware similar in quantity, type, and quality to that indicated for this Project. Supplier to be recognized as a factory direct distributor by the manufacturer of the primary materials with a warehousing facility in the Project's vicinity. Supplier to have on staff, a certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) available to Owner, Architect, and Contractor, at reasonable times during the Work for consultation.
 2. Installer: Qualified tradesperson skilled in the application of commercial grade hardware with experience installing door hardware similar in quantity, type, and quality as indicated for this Project.
 3. Architectural Hardware Consultant: Person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and meets these requirements:
 - a. For door hardware: DHI certified AHC or DHC.
 - b. Can provide installation and technical data to Architect and other related subcontractors.
 - c. Can inspect and verify components are in working order upon completion of installation.

- d. Capable of producing wiring diagram and coordinating installation of electrified hardware with Architect and electrical engineers.
 4. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.
- B. Certifications:
1. Fire-Rated Door Openings:
 - a. Provide door hardware for fire-rated openings that complies with NFPA 80 and requirements of authorities having jurisdiction.
 - b. Provide only items of door hardware that are listed products tested by UL LLC, Intertek Testing Services, or other testing and inspecting organizations acceptable to authorities having jurisdiction for use on types and sizes of doors indicated, based on testing at positive pressure and according to NFPA 252 or UL 10C and in compliance with requirements of fire-rated door and door frame labels.
 2. Smoke and Draft Control Door Assemblies:
 - a. Provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105
 - b. Comply with the maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at tested pressure differential of 0.3-inch wg (75 Pa) of water.
 3. Electrified Door Hardware
 - a. Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction.
 4. Accessibility Requirements:
 - a. Comply with governing accessibility regulations cited in "REFERENCES" article 087100, 1.02.D3 herein for door hardware on doors in an accessible route. This project must comply with all Federal Americans with Disability Act regulations and all Local Accessibility Regulations.
- C. Pre-Installation Meetings
1. Keying Conference
 - a. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including:
 - 1) Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
 - 2) Preliminary key system schematic diagram.
 - 3) Requirements for key control system.
 - 4) Requirements for access control.
 - 5) Address for delivery of keys.
 2. Pre-installation Conference
 - a. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - b. Inspect and discuss preparatory work performed by other trades.
 - c. Inspect and discuss electrical roughing-in for electrified door hardware.
 - d. Review sequence of operation for each type of electrified door hardware.

- e. Review required testing, inspecting, and certifying procedures.
 - f. Review questions or concerns related to proper installation and adjustment of door hardware.
3. Electrified Hardware Coordination Conference:
- a. Prior to ordering electrified hardware, schedule and hold meeting to coordinate door hardware with security, electrical, doors and frames, and other related suppliers.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site. Promptly replace products damaged during shipping.
- B. Tag each item or package separately with identification coordinated with final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package. Deliver each article of hardware in manufacturer's original packaging.
- C. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.
- D. Provide secure lock-up for door hardware delivered to Project. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.
- E. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.
- F. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

1.06 COORDINATION

- A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete.
- B. Installation Templates: Distribute for doors, frames, and other work specified to be factory or shop prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.
- D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

1.07 WARRANTY

- A. Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within published warranty period.
 - 1. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.
 - 2. Warranty Period: Beginning from date of Substantial Completion, for durations indicated in manufacturer's published listings.
 - a. Mechanical Warranty
 - 1) Locks
 - a) 10 years
 - 2) Exit Devices
 - a) 10 years
 - 3) Closers
 - a) 30 years
 - 4) Automatic Operators
 - a) 2 years
 - b. Electrical Warranty
 - 1) Locks
 - a) 3 years
 - 2) Exit Devices
 - a) 3 years

1.08 MAINTENANCE

- A. Furnish complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.
- B. Turn over unused materials to Owner for maintenance purposes.

PART 2 -PRODUCTS

2.01 MANUFACTURERS

- A. Approval of alternate manufacturers and/or products other than those listed as "Scheduled Manufacturer" or "Acceptable Manufacturers" in the individual article for the product category are only to be considered by official substitution request in accordance with section 01 25 00.
- B. Approval of products from manufacturers indicated in "Acceptable Manufacturers" is contingent upon those products providing all functions and features and meeting all requirements of scheduled manufacturer's product.
- C. Where specified hardware is not adaptable to finished shape or size of members requiring hardware, furnish suitable types having same operation and quality as type specified, subject to Architect's approval.

2.02 MATERIALS

A. Fabrication

1. Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. provide screws according to manufacturer's recognized installation standards for application intended.
2. Finish exposed screws to match hardware finish, or, if exposed in surfaces of other work, to match finish of this other work including prepared for paint surfaces to receive painted finish.
3. Provide concealed fasteners wherever possible for hardware units exposed when door is closed. Coordinate with "Metal Doors and Frames", "Flush Wood Doors", "Stile and Rail Wood Doors" to ensure proper reinforcements. Advise the Architect where visible fasteners, such as thru bolts, are required.

B. Provide screws, bolts, expansion shields, drop plates and other devices necessary for hardware installation.

1. Where fasteners are exposed to view: Finish to match adjacent door hardware material.

C. Cable and Connectors:

1. Where scheduled in the hardware sets, provide each item of electrified hardware and wire harnesses with number and gage of wires enough to accommodate electric function of specified hardware.
2. Provide Molex connectors that plug directly into connectors from harnesses, electric locking and power transfer devices.
3. Provide through-door wire harness for each electrified locking device installed in a door and wire harness for each electrified hinge, electrified continuous hinge, electrified pivot, and electric power transfer for connection to power supplies.

2.03 HINGES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
 - a. Ives 5BB series
2. Acceptable Manufacturers and Products:
 - a. McKinney TB series
 - b. Best FBB series

B. Requirements:

1. Provide hinges conforming to ANSI/BHMA A156.1.
2. Provide five knuckle, ball bearing hinges.
3. 1-3/4 inch (44 mm) thick doors, up to and including 36 inches (914 mm) wide:
 - a. Exterior: Standard weight, bronze or stainless steel, 4-1/2 inches (114 mm) high

- b. Interior: Standard weight, steel, 4-1/2 inches (114 mm) high
- 4. 1-3/4 inch (44 mm) thick doors over 36 inches (914 mm) wide:
 - a. Exterior: Heavy weight, bronze/stainless steel, 5 inches (127 mm) high
 - b. Interior: Heavy weight, steel, 5 inches (127 mm) high
- 5. 2 inches or thicker doors:
 - a. Exterior: Heavy weight, bronze or stainless steel, 5 inches (127 mm) high
 - b. Interior: Heavy weight, steel, 5 inches (127 mm) high
- 6. Adjust hinge width for door, frame, and wall conditions to allow proper degree of opening.
- 7. Provide three hinges per door leaf for doors 90 inches (2286 mm) or less in height, and one additional hinge for each 30 inches (762 mm) of additional door height.
- 8. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:
 - a. Steel Hinges: Steel pins
 - b. Non-Ferrous Hinges: Stainless steel pins
 - c. Out-Swinging Exterior Doors: Non-removable pins
 - d. Out-Swinging Interior Lockable Doors: Non-removable pins
 - e. Interior Non-lockable Doors: Non-rising pins
- 9. Provide hinges with electrified options as scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware. Locate electric hinge at second hinge from bottom or nearest to electrified locking component. Provide mortar guard for each electrified hinge specified.

2.04 CONTINUOUS HINGES

A. Manufacturers:

- 1. Scheduled Manufacturer:
 - a. Ives
- 2. Acceptable Manufacturers:
 - a. Select
 - b. Roton

B. Requirements:

- 1. Provide aluminum geared continuous hinges conforming to ANSI/BHMA A156.26, Grade 1.
- 2. Provide aluminum geared continuous hinges, where specified in the hardware sets, fabricated from 6063-T6 aluminum.
- 3. Provide split nylon bearings at each hinge knuckle for quiet, smooth, self-lubricating operation.
- 4. Provide hinges capable of supporting door weights up to 450 pounds, and successfully tested for 1,500,000 cycles.
- 5. On fire-rated doors, provide aluminum geared continuous hinges classified for use on rated doors by testing agency acceptable to authority having jurisdiction.

6. Provide aluminum geared continuous hinges with electrified option scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware.
7. Provide hinges 1 inch (25 mm) shorter in length than nominal height of door, unless otherwise noted or door details require shorter length and with symmetrical hole pattern.

2.05 ELECTRIC POWER TRANSFER

A. Manufacturers:

1. Scheduled Manufacturer and Product:
 - a. Von Duprin EPT-10
2. Acceptable Manufacturers and Products:
 - a. Securitron CEPT-10
 - b. Security Door Controls PTM

B. Requirements:

1. Provide power transfer with electrified options as scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware.
2. Locate electric power transfer per manufacturer's template and UL requirements, unless interference with operation of door or other hardware items.

2.06 FLUSH BOLTS

A. Manufacturers:

1. Scheduled Manufacturer:
 - a. Ives
2. Acceptable Manufacturers:
 - a. Rockwood
 - b. Trimco

B. Requirements:

1. Provide automatic, constant latching, and manual flush bolts with forged bronze or stainless-steel face plates, extruded brass levers, and with wrought brass guides and strikes. Provide 12 inch (305 mm) steel or brass rods at doors up to 90 inches (2286 mm) in height. For doors over 90 inches (2286 mm) in height increase top rods by 6 inches (152 mm) for each additional 6 inches (152 mm) of door height. Provide dust-proof strikes at each bottom flush bolt.

2.07 COORDINATORS

A. Manufacturers:

1. Scheduled Manufacturer:
 - a. Ives
 2. Acceptable Manufacturers:
 - a. Trimco
 - b. Rockwood
- B. Requirements:
1. Where pairs of doors are equipped with automatic flush bolts, an astragal, or other hardware that requires synchronized closing of the doors, provide bar-type coordinating device, surface applied to underside of stop at frame head.
 2. Provide filler bar of correct length for unit to span entire width of opening, and appropriate brackets for parallel arm door closers, surface vertical rod exit device strikes, or other stop mounted hardware. Factory-prepared coordinators for vertical rod devices as specified.

2.08 MORTISE LOCKS

- A. Manufacturers and Products:
1. Scheduled Manufacturer and Product:
 - a. Schlage L9000 series
 2. Acceptable Manufacturers and Products:
 - a. Sargent 8200 series
 - b. Best 45H series
- B. Requirements:
1. Provide mortise locks conforming to ANSI/BHMA A156.13 Series 1000, Grade 1, and UL Listed for 3-hour fire doors.
 2. Indicators: Where specified, provide indicator window measuring a minimum 2-3/5-inch x 3/5 inch with 180-degree visibility. Provide messages color-coded using ANSI Z535 Safety Red with full text and/or symbols, as scheduled, for easy visibility. When applicable allows for lock status indication on both sides of the door.
 3. Provide locks manufactured from heavy gauge steel, containing components of steel with a zinc dichromate plating for corrosion resistance.
 4. Provide lock case that is multi-function and field reversible for handing without opening case. Cylinders: Refer to "KEYING" article, herein.
 5. Provide locks with standard 2-3/4 inches (70 mm) backset with full 3/4 inch (19 mm) throw stainless steel mechanical anti-friction latchbolt. Provide deadbolt with full 1-inch (25 mm) throw, constructed of stainless steel.
 6. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim. Provide electrified options as scheduled in the hardware sets. Where scheduled, provide switches and sensors integrated into the locks and latches.
 7. Provide motor based electrified locksets that comply with the following requirements:
 - a. Universal input voltage - single chassis accepts 12 or 24VDC to allow for changes in the field without changing lock chassis.

- b. Fail Safe/Fail Secure – changing mode between electrically locked (fail safe) and electrically unlocked (fail secure) is field selectable without opening the lock case.
 - c. Low maximum current draw – maximum 0.4 amps to allow for multiple locks on a single power supply.
 - d. Low holding current – maximum 0.01 amps to produce minimal heat, eliminate “hot levers” in electrically locked applications, and to provide reliable operation in wood doors that provide minimal ventilation and air flow.
 - e. Connections – provide quick-connect Molex system standard.
8. Lever Trim: Solid brass, bronze, or stainless steel, cast or forged in design specified, with wrought roses and external lever spring cages. Provide thru-bolted levers with 2-piece spindles.
- a. Lever Design: 17A

2.09 EXIT DEVICES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
 - a. Von Duprin 98/35A series
2. Acceptable Manufacturers and Products:
 - a. Detex Advantex series
 - b. Precision APEX 2000 series

B. Requirements:

1. Provide exit devices tested to ANSI/BHMA A156.3 Grade 1 and UL listed for Panic Exit or Fire Exit Hardware.
2. Cylinders: Refer to "KEYING" article, herein.
3. Provide smooth touchpad type exit devices, fabricated of brass, bronze, stainless steel, or aluminum, plated to standard architectural finishes to match balance of door hardware.
4. Touchpad must extend a minimum of one half of door width. No plastic inserts are allowed in touchpads.
5. Provide exit devices with deadlatching feature for security and for future addition of alarm kits and/or other electrified requirements.
6. Provide exit devices with weather resistant components that can withstand harsh conditions of various climates and corrosive cleaners used in outdoor pool environments.
7. Provide flush end caps for exit devices.
8. Provide exit devices with manufacturer's approved strikes.
9. Provide exit devices cut to door width and height. Install exit devices at height recommended by exit device manufacturer, allowable by governing building codes, and approved by Architect.
10. Mount mechanism case flush on face of doors or provide spacers to fill gaps behind devices. Where glass trim or molding projects off face of door, provide glass bead kits.
11. Provide cylinder or hex-key dogging as specified at non fire-rated openings.

12. Removable Mullions: 2 inches (51 mm) x 3 inches (76 mm) steel tube. Where scheduled as keyed removable mullion, provide type that can be removed by use of a keyed cylinder, which is self-locking when re-installed.
13. Provide factory drilled weep holes for exit devices used in full exterior application, highly corrosive areas, and where noted in hardware sets.
14. Provide electrified options as scheduled.
15. Top latch mounting: double- or single-tab mount for steel doors, face mount for aluminum doors eliminating requirement of tabs, and double tab mount for wood doors.
16. Provide exit devices with optional trim designs to match other lever and pull designs used on the project.

2.10 ELECTRIC STRIKES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
 - a. Von Duprin 6000 Series
2. Acceptable Manufacturers and Products:
 - a. Folger Adam 300 Series
 - b. HES 1006 Series

B. Requirements:

1. Provide electric strikes designed for use with type of locks shown at each opening.
2. Provide electric strikes UL Listed as burglary resistant that are tested to a minimum endurance test of 1,000,000 cycles.
3. Where required, provide electric strikes UL Listed for fire doors and frames.
4. Provide transformers and rectifiers for each strike as required. Verify voltage with electrical contractor.

2.11 POWER SUPPLIES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
 - a. Schlage/Von Duprin PS900 Series
2. Acceptable Manufacturers and Products:
 - a. Securitron BPS series
 - b. Security Door Controls 600 series

B. Requirements:

1. Provide power supplies approved by manufacturer of supplied electrified hardware.

2. Provide appropriate quantity of power supplies necessary for proper operation of electrified locking components as recommended by manufacturer of electrified locking components with consideration for each electrified component using power supply, location of power supply, and approved wiring diagrams. Locate power supplies as directed by Architect.
3. Provide regulated and filtered 24 VDC power supply, and UL class 2 listed.
4. Provide power supplies with the following features:
 - a. 12/24 VDC Output, field selectable.
 - b. Class 2 Rated power limited output.
 - c. Universal 120-240 VAC input.
 - d. Low voltage DC, regulated and filtered.
 - e. Polarized connector for distribution boards.
 - f. Fused primary input.
 - g. AC input and DC output monitoring circuit w/LED indicators.
 - h. Cover mounted AC Input indication.
 - i. Tested and certified to meet UL294.
 - j. NEMA 1 enclosure.
 - k. Hinged cover w/lock down screws.
 - l. High voltage protective cover.

2.12 CYLINDERS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
 - a. Schlage
2. Acceptable Manufacturers and Products:
 - a. Best
 - b. Sargent

B. Requirements:

1. Provide cylinders/cores compliant with ANSI/BHMA A156.5; latest revision; cylinder face finished to match lockset; manufacturer's series as indicated. Refer to "KEYING" article, herein.
2. Provide cylinders in the below-listed configuration(s), distributed throughout the Project as indicated.
 - a. Patented Open: cylinder with interchangeable core
3. Patent Protection: Cylinders/cores requiring use of restricted, patented keys, patent protected.
4. Nickel silver bottom pins.

2.13 KEYING

A. Scheduled System:

1. New factory registered system:
 - a. Provide a factory registered keying system, complying with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.

B. Requirements:

1. Construction Keying:
 - a. Replaceable Construction Cores.
 - 1) Provide temporary construction cores replaceable by permanent cores, furnished in accordance with the following requirements.
 - a) 3 construction control keys
 - b) 12 construction change (day) keys.
 - 2) Owner or Owner's Representative will replace temporary construction cores with permanent cores.
 2. Permanent Keying:
 - a. Provide permanent cylinders/cores keyed by the manufacturer according to the following key system.
 - 1) Master Keying system as directed by the Owner.
 - b. Forward bitting list and keys separately from cylinders, by means as directed by Owner. Failure to comply with forwarding requirements will be cause for replacement of cylinders/cores involved at no additional cost to Owner.
 - c. Provide keys with the following features:
 - 1) Material: Nickel silver; minimum thickness of .107-inch (2.3mm)
 - 2) Patent Protection: Keys and blanks protected by one or more utility patent(s).
 - d. Identification:
 - 1) Mark permanent cylinders/cores and keys with applicable blind code for identification. Do not provide blind code marks with actual key cuts.
 - 2) Identification stamping provisions must be approved by the Architect and Owner.
 - 3) Stamp cylinders/cores and keys with Owner's unique key system facility code as established by the manufacturer; key symbol and embossed or stamped with "DO NOT DUPLICATE" along with the "PATENTED" or patent number to enforce the patent protection.
 - 4) Failure to comply with stamping requirements will be cause for replacement of keys involved at no additional cost to Owner.
 - 5) Forward permanent cylinders/cores to Owner, separately from keys, by means as directed by Owner.
 - e. Quantity: Furnish in the following quantities.
 - 1) Permanent Control Keys: 3.
 - 2) Master Keys: 6.
 - 3) Change (Day) Keys: 3 per cylinder/core that is keyed differently
 - 4) Key Blanks: Quantity as determined in the keying meeting.

2.14 KEY CONTROL SYSTEM

A. Manufacturers:

1. Scheduled Manufacturer:
 - a. Telkee
2. Acceptable Manufacturers:
 - a. HPC
 - b. Lund

B. Requirements:

1. Provide key control system, including envelopes, labels, tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet, all as recommended by system manufacturer, with capacity for 150% of number of locks required for Project.
 - a. Provide complete cross index system set up by hardware supplier, and place keys on markers and hooks in cabinet as determined by final key schedule.
 - b. Provide hinged-panel type cabinet for wall mounting.

2.15 DOOR CLOSERS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
 - a. LCN 4010/4110/4020 series
2. Acceptable Manufacturers and Products:
 - a. Corbin-Russwin DC8000 series
 - b. Sargent 281 series

B. Requirements:

1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. Certify surface mounted mechanical closers to meet fifteen million (15,000,000) full load cycles. ISO 9000 certify closers. Stamp units with date of manufacture code.
2. Provide door closers with fully hydraulic, full rack and pinion action with high strength cast iron cylinder, and full complement bearings at shaft.
3. Cylinder Body: 1-1/2-inch (38 mm) diameter with 11/16-inch (17 mm) diameter double heat-treated pinion journal.
4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards.
6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and backcheck.
7. Provide closers with solid forged steel main arms and factory assembled heavy-duty forged forearms for parallel arm closers. When closers are parallel arm mounted, provide closers which mount within 6-inch (152 mm) top rail without use of mounting plate so that closer is not visible through vision panel from pull side.
8. Pressure Relief Valve (PRV) Technology: Not permitted.
9. Finish for Closer Cylinders, Arms, Adapter Plates, and Metal Covers: Powder coating finish which has been certified to exceed 100 hours salt spray testing as described in ANSI/BHMA Standard A156.4 and ASTM B117, or has special rust inhibitor (SRI).

10. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.

2.16 ELECTRO-HYDRAULIC AUTOMATIC OPERATORS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
 - a. LCN 4600 series
2. Acceptable Manufacturers and Products:
 - a. Precision D4990 series
 - b. Besam Power Swing

B. Requirements:

1. Provide low energy automatic operator units with hydraulic closer complying with ANSI/BHMA A156.19.
2. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
3. Provide units with conventional door closer opening and closing forces unless power operator motor is activated. Provide door closer assembly with adjustable spring size, back-check, and opening and closing speed adjustment valves to control door
4. Provide units with on/off switch for manual operation, motor start up delay, vestibule interface delay, electric lock delay, and door hold open delay.
5. Provide drop plates, brackets, and adapters for arms as required for details.
6. Provide actuator switches and receivers for operation as specified.
7. Provide weather-resistant actuators at exterior applications.
8. Provide key switches with LED's, recommended and approved by manufacturer of automatic operator as required for function described in operation description of hardware group below. Cylinders: Refer to "KEYING" article, herein.
9. Provide complete assemblies of controls, switches, power supplies, relays, and parts/material recommended and approved by manufacturer of automatic operator for each individual leaf. Actuators control both doors simultaneously at pairs. Sequence operation of exterior and vestibule doors with automatic operators to allow ingress or egress through both sets of openings as directed by Architect. Locate actuators, key switches, and other controls as directed by Architect.
10. Provide units with vestibule inputs that allow sequencing operation of two units, and SPDT relay for interfacing with latching or locking devices.

2.17 DOOR TRIM

A. Manufacturers:

1. Scheduled Manufacturer:
 - a. Ives

2. Acceptable Manufacturers:
 - a. Trimco
 - b. Rockwood

B. Requirements:

1. Provide push plates, push bars, pull plates, pulls, and hands-free reversible door pulls with diameter and length as scheduled.

2.18 PROTECTION PLATES

A. Manufacturers:

1. Scheduled Manufacturer:
 - a. Ives
2. Acceptable Manufacturers:
 - a. Trimco
 - b. Rockwood

B. Requirements:

1. Provide protection plates with a minimum of 0.050 inch (1 mm) thick, beveled four edges as scheduled. Furnish with sheet metal or wood screws, finished to match plates.
2. Size plates 2 inches (51 mm) less width of door on single doors, pairs of doors with a mullion, and doors with edge guards. Size plates 1 inch (25 mm) less width of door on pairs without a mullion or edge guards.
3. At fire rated doors, provide protection plates over 16 inches high with UL label.

2.19 OVERHEAD STOPS AND OVERHEAD STOP/HOLDERS

A. Manufacturers:

1. Scheduled Manufacturers:
 - a. Glynn-Johnson
2. Acceptable Manufacturers:
 - a. Rixson
 - b. Sargent

B. Requirements:

1. Provide overhead stop at any door where conditions do not allow for a wall stop or floor stop presents tripping hazard.

2.20 DOOR STOPS AND HOLDERS

A. Manufacturers:

1. Scheduled Manufacturer:

- a. Ives
- 2. Acceptable Manufacturers:
 - a. Trimco
 - b. Rockwood
- B. Provide door stops at each door leaf:
 - 1. Provide wall stops wherever possible. Provide concave type where lockset has a push button or thumbturn.
 - 2. Where a wall stop cannot be used, provide universal floor stops.
 - 3. Where wall or floor stop cannot be used, provide overhead stop.
 - 4. Provide roller bumper where doors open into each other and overhead stop cannot be used.

2.21 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING

- A. Manufacturers:
 - 1. Scheduled Manufacturer:
 - a. Zero International
 - 2. Acceptable Manufacturers:
 - a. National Guard
 - b. Pemko
- B. Requirements:
 - 1. Provide thresholds, weather-stripping, and gasketing systems as specified and per architectural details. Match finish of other items.
 - 2. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
 - 3. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient or flexible seal strip is easily replaceable and readily available.
 - 4. Size thresholds 1/2 inch (13 mm) high by 5 inches (127 mm) wide by door width unless otherwise specified in the hardware sets or detailed in the drawings.

2.22 SILENCERS

- A. Manufacturers:
 - 1. Scheduled Manufacturer:
 - a. Ives
 - 2. Acceptable Manufacturers:
 - a. Rockwood
 - b. Trimco

B. Requirements:

1. Provide "push-in" type silencers for hollow metal or wood frames.
2. Provide one silencer per 30 inches (762 mm) of height on each single frame, and two for each pair frame.
3. Omit where gasketing is specified.

2.23 DOOR POSITION SWITCHES

A. Manufacturers:

1. Scheduled Manufacturer:
 - a. Schlage
2. Acceptable Manufacturers:
 - a. GE-Interlogix
 - b. Sargent

B. Requirements:

1. Provide recessed or surface mounted type door position switches as specified.
2. Coordinate door and frame preparations with door and frame suppliers. If switches are being used with magnetic locking device, provide minimum of 4 inches (102 mm) between switch and magnetic locking device.

2.24 FINISHES

A. FINISH: BHMA 626/652 (US26D); EXCEPT:

1. Hinges at Exterior Doors: BHMA 630 (US32D)
2. Aluminum Geared Continuous Hinges: BHMA 628 (US28)
3. Push Plates, Pulls, and Push Bars: BHMA 630 (US32D)
4. Protection Plates: BHMA 630 (US32D)
5. Overhead Stops and Holders: BHMA 630 (US32D)
6. Door Closers: Powder Coat to Match
7. Wall Stops: BHMA 630 (US32D)
8. Latch Protectors: BHMA 630 (US32D)
9. Weatherstripping: Clear Anodized Aluminum
10. Thresholds: Mill Finish Aluminum

B. FINISH: BHMA 643E/716 (US11); EXCEPT:

1. Door Closers: Powder Coat to Match.
2. Weatherstripping: Dark Bronze Anodized Aluminum.
3. Thresholds: Extruded Architectural Bronze, Oil-Rubbed

PART 3 -EXECUTION

3.01 EXAMINATION

- A. Prior to installation of hardware, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance. Verify doors, frames, and walls have been properly reinforced for hardware installation.
- B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- C. Submit a list of deficiencies in writing and proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Mount door hardware units at heights to comply with the following, unless otherwise indicated or required to comply with governing regulations.
 - 1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
 - 2. Custom Steel Doors and Frames: HMMA 831.
 - 3. Interior Architectural Wood Flush Doors: ANSI/WDMA I.S. 1A
 - 4. Installation Guide for Doors and Hardware: DHI TDH-007-20
- B. Install door hardware in accordance with NFPA 80, NFPA 101 and provide post-install inspection, testing as specified in section 1.03.E unless otherwise required to comply with governing regulations.
- C. Install each hardware item in compliance with manufacturer's instructions and recommendations, using only fasteners provided by manufacturer.
- D. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.
- E. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.
- F. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- G. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.
- H. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated.
- I. Lock Cylinders:
 - 1. Install construction cores to secure building and areas during construction period.
 - 2. Replace construction cores with permanent cores as indicated in keying section.
 - 3. Furnish permanent cores to Owner for installation.

- J. Wiring: Coordinate with Division 26, ELECTRICAL and Division 28 ELECTRONIC SAFETY AND SECURITY sections for:
 - 1. Conduit, junction boxes and wire pulls.
 - 2. Connections to and from power supplies to electrified hardware.
 - 3. Connections to fire/smoke alarm system and smoke evacuation system.
 - 4. Connection of wire to door position switches and wire runs to central room or area, as directed by Architect.
 - 5. Connections to panel interface modules, controllers, and gateways.
 - 6. Testing and labeling wires with Architect's opening number.
- K. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.
- L. Continuous Hinges: Re-locate the door and frame fire rating labels where they will remain visible so that the hinge does not cover the label once installed.
- M. Door Closers & Auto Operators: Mount closers/operators on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Mount closers/operators so they are not visible in corridors, lobbies and other public spaces unless approved by Architect.
- N. Overhead Stops/Holders: Mount overhead stops/holders on room side of corridor doors, inside of exterior doors, and stair side of stairway doors.
- O. Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings or in equipment room, or alternate location as directed by Architect.
- P. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."
- Q. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they may impede traffic or present tripping hazard.
- R. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
- S. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- T. Door Bottoms and Sweeps: Apply to bottom of door, forming seal with threshold when door is closed.

3.03 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
 - 1. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
 - 2. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.

- B. Occupancy Adjustment: Approximately three to six months after date of Substantial Completion, examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors and door hardware.

3.04 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items per manufacturer's instructions to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

3.05 DOOR HARDWARE SCHEDULE

- A. The intent of the hardware specification is to specify the hardware for interior and exterior doors, and to establish a type, continuity, and standard of quality. However, it is the door hardware supplier's responsibility to thoroughly review existing conditions, schedules, specifications, drawings, and other Contract Documents to verify the suitability of the hardware specified.
- B. Discrepancies, conflicting hardware, and missing items are to be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application.
- C. Hardware items are referenced in the following hardware schedule. Refer to the above specifications for special features, options, cylinders/keying, and other requirements.
- D. Hardware Sets:

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HARDWARE GROUP NO. 01

For use on Door #(s):

121.1 122.1

Provide each opening with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	EA	PUSH PLATE	8200 6" X 16"	630	IVE
1	EA	PULL PLATE	8303 10" 4" X 16"	630	IVE
1	EA	SURFACE CLOSER	4011	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
3	EA	SILENCER	SR64/SR65 AS REQ'D	GRY	IVE

HARDWARE GROUP NO. 02

For use on Door #(s):

126.1

Provide each opening with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	EA	OFFICE/ENTRY LOCK	L9050J 17A L583-363	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	WALL STOP	WS406/407CVX	630	IVE
3	EA	SILENCER	SR64/SR65 AS REQ'D	GRY	IVE

HARDWARE GROUP NO. 03

For use on Door #(s):

130.1

Provide each opening with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
2	EA	MANUAL FLUSH BOLT	FB358/FB458 (AS REQ'D)	626	IVE
1	EA	DUST PROOF STRIKE	DP2	626	IVE
1	EA	OFFICE/ENTRY LOCK	L9050J 17A L583-363	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	WALL STOP	WS33/WS33X	626	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
2	EA	SILENCER	SR64/SR65 AS REQ'D	GRY	IVE

HARDWARE GROUP NO. 04

For use on Door #(s):

115.1

Provide each opening with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	CORRIDOR LOCK W/ OUTSIDE & INSIDE INDICATOR	L9456J 17A L583-363 OS-OCC IS-LOC DM XL13-369	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	ELECTRIC STRIKE	6211 FSE 12/16/24/28 VAC/VDC	630	VON
1	EA	SURF. AUTO OPERATOR	4630	689	LCN
2	EA	WALL MOUNT PUSHPLATE	8310-852T	630	LCN
2	EA	MOUNT BOX	8310-869F		LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
3	EA	SILENCER	SR64/SR65 AS REQ'D	GRY	IVE
1	EA	POWER SUPPLY	PS902	LGR	SCE

PRESSING EXTERIOR ACTUATOR WHEN BATHROOM IS NOT IN USE RELEASES ELECTRIC STRIKE AND SIGNALS AUTOMATIC OPERATOR TO OPEN DOOR. THROWING THUMBTURN DISABLES EXTERIOR ACTUATOR. PRESSING INTERIOR ACTUATOR RELEASES ELECTRIC STRIKE AND SIGNALS AUTOMATIC OPERATOR TO OPEN DOOR.

XL13-369 IS A SPECIAL PART NUMBER WHERE DEADBOLT MONITORING IS INCLUDED, BUT DEADBOLT IS EXCLUDED IN ORDER TO SHUNT OUTSIDE ACTUATOR. RFQ REQUIRED PRIOR TO ORDER.

HARDWARE GROUP NO. 05

For use on Door #(s):

119A.1 120B.1

Provide each opening with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	EA	OFFICE W/SIM RETRACT W/ OUTSIDE & INSIDE INDICATOR	L9056J 17A L583-363 OS-OCC IS-LOC	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	SURFACE CLOSER	4111 SCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
3	EA	SILENCER	SR64/SR65 AS REQ'D	GRY	IVE

HARDWARE GROUP NO. 06

For use on Door #(s):
113.1

Provide each opening with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	EA	OFFICE W/SIM RETRACT W/ OUTSIDE & INSIDE INDICATOR	L9056J 17A L583-363 OS-OCC IS-LOC	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	SURFACE CLOSER	4011	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
3	EA	SILENCER	SR64/SR65 AS REQ'D	GRY	IVE

HARDWARE GROUP NO. 07

For use on Door #(s):
125.1

Provide each opening with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	EA	PANIC HARDWARE	LD-98-L-2SI-17	626	VON
1	EA	FSIC RIM HOUSING	20-079	626	SCH
1	EA	THUMBTURN CYLINDER	XB13-379	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	SURFACE CLOSER	4111 EDA	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
3	EA	SILENCER	SR64/SR65 AS REQ'D	GRY	IVE

HARDWARE GROUP NO. 08

For use on Door #(s):
130.2

Provide each opening with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	EA	OFFICE/ENTRY LOCK	L9050J 17A L583-363	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	SURFACE CLOSER	4111 EDA	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP/HOLDER	WS40	626	IVE
3	EA	SILENCER	SR64/SR65 AS REQ'D	GRY	IVE

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HARDWARE GROUP NO. 09

For use on Door #(s):

102.1

Provide each opening with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 5 X 4.5 NRP	652	IVE
1	EA	ELEC CLASSROOM LOCK	CO-100-MS-70-KP-SPA-J 4B BATTERY OPERATED	626	SCE
1	EA	FSIC CORE	23-030	626	SCH
1	EA	SURFACE CLOSER	4111 EDA	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
3	EA	SILENCER	SR64/SR65 AS REQ'D	GRY	IVE

DOOR NORMALLY LOCKED. ENTERING A VALID COMBINATION ON THE STAND ALONE BATTERY POWERED KEYPAD LOCK ALLOWS ACCESS.

HARDWARE GROUP NO. 10

For use on Door #(s):

119B.1 120A.1

Provide each opening with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 5 X 4.5 NRP	652	IVE
1	EA	STOREROOM LOCK	L9080J 17A	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	SURFACE CLOSER	4111 SCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
3	EA	SILENCER	SR64/SR65 AS REQ'D	GRY	IVE

HARDWARE GROUP NO. 11

For use on Door #(s):

114.1 123.1 127.1

Provide each opening with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	EA	STOREROOM LOCK	L9080J 17A	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	SURFACE CLOSER	4011	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
3	EA	SILENCER	SR64/SR65 AS REQ'D	GRY	IVE

HARDWARE GROUP NO. 12

For use on Door #(s):

125.2 131.1 133.1

Provide each opening with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	CONT. HINGE	224XY	628	IVE
1	EA	CONST LATCHING BOLT	FB51P/FB61P (AS REQ'D)	630	IVE
1	EA	STOREROOM LOCK	L9080J 17A	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	COORDINATOR	COR X FL (MB AS REQ'D)	628	IVE
2	EA	SURFACE CLOSER	4111 SHCUSH	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	630	IVE
1	SET	OVERLAPPING ASTRAGAL	139A-S	A	ZER
1	EA	RAIN DRIP	142AA	AA	ZER
1	SET	GASKETING	429AA-S	AA	ZER
2	EA	DOOR SWEEP	8198AA	AA	ZER
1	EA	THRESHOLD	655A-223	A	ZER

HARDWARE GROUP NO. 13

For use on Door #(s):

129.1

Provide each opening with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	EA	CONST LATCHING BOLT	FB51P/FB61P (AS REQ'D)	630	IVE
1	EA	DUST PROOF STRIKE	DP2	626	IVE
1	EA	STOREROOM LOCK	L9080J 17A	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	COORDINATOR	COR X FL (MB AS REQ'D)	628	IVE
2	EA	OH STOP	100S	630	GLY
2	EA	SURFACE CLOSER	4011 ST-1544	689	LCN
2	EA	MOUNTING PLATE	4020-18	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	630	IVE
2	EA	SILENCER	SR64/SR65 AS REQ'D	GRY	IVE

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HARDWARE GROUP NO. 14

For use on Door #(s):

119.1 120.1

Provide each opening with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	EA	PANIC HARDWARE	LD-98-EO	626	VON
1	EA	ELEC EXIT DEVICE TRIM	CO-100-993R-70-KP-SPA-J 4B BATTERY OPERATED	626	SCE
1	EA	FSIC CORE	23-030	626	SCH
1	EA	SURFACE CLOSER	4111 EDA	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
3	EA	SILENCER	SR64/SR65 AS REQ'D	GRY	IVE

DOOR NORMALLY LOCKED. ENTERING A VALID COMBINATION ON THE STAND ALONE
BATTERY POWERED KEYPAD LOCK ALLOWS ACCESS.

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HARDWARE GROUP NO. 15

For use on Door #(s):
100.1

Provide each opening with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	CONT. HINGE	112XY EPT	710	IVE
2	EA	POWER TRANSFER	EPT10	695	VON
1	EA	REMOVABLE MULLION	KR4954 STAB	695	VON
1	EA	ELEC PANIC HARDWARE	LX-RX-QEL-98-NL-OP	313	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-98-EO	313	VON
1	EA	FSIC MORTISE HOUSING	20-059 (BLOCKING RINGS & CAM AS REQ)	643e	SCH
1	EA	FSIC RIM HOUSING	20-079	643e	SCH
2	EA	FSIC CORE	23-030	613	SCH
2	EA	LONG DOOR PULL	9264F 72"	BLK	IVE
1	EA	OH STOP	100S	643E/7 16	GLY
1	EA	OH STOP	100SE	643E/7 16	GLY
1	EA	SURFACE CLOSER	4021	695	LCN
1	EA	SURF. AUTO OPERATOR	4640	695	LCN
1	EA	MOUNTING PLATE	4020-18G	695	LCN
1	EA	ACTUATOR, TOUCH	8310-836T	630	LCN
1	EA	WALL MOUNT PUSHPLATE	8310-852T	630	LCN
1	EA	MOUNT BOX	8310-869F		LCN
1	EA	MULLION SEAL	8780NBK PSA	BK	ZER
1	EA	WEATHERSTRIPPING/GA SKETING	BY DOOR/FRAME MANUFACTURER		
2	EA	DOOR SWEEP	8198D	D	ZER
1	EA	THRESHOLD	655A-223	A	ZER
1	EA	MULTITECH READER	MTB11/MTB15 - BY ACCESS CONTROL PROVIDER	BLK	SCE
2	EA	DOOR CONTACT	679-05 WD/HM AS REQ'D	BLK	SCE
1	EA	POWER SUPPLY	PS902 900-4RL	LGR	SCE

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UNLOCKED HOURS:

PANIC DEVICE(S) ELECTRICALLY DOGGED (I.E. IN PUSH/PULL MODE) AND BOTH AUTO OPERATOR ACTUATORS ACTIVE. PUSHING EITHER ACTUATOR SIGNALS AUTOMATIC OPERATOR TO MOMENTARILY OPEN THE DOOR. PANIC DEVICE(S) LATCH AND LOCK WITH LOSS OF POWER.

LOCKED HOURS:

DOOR NORMALLY CLOSED AND LOCKED AND EXTERIOR ACTUATOR BUTTON INACTIVE. PRESENTING VALID CREDENTIAL TO READER MOMENTARILY RETRACTS PANIC DEVICE LATCH AND MOMENTARILY ENABLES EXTERIOR ACTUATOR BUTTON. PUSHING ENABLED EXTERIOR ACTUATOR BUTTON SIGNALS AUTOMATIC OPERATOR TO MOMENTARILY OPEN DOOR. INTERIOR ACTUATOR ENABLED AT ALL TIMES. PUSHING THE INTERIOR ACTUATOR BUTTON MOMENTARILY RETRACTS PANIC DEVICE LATCH AND SIGNALS AUTOMATIC OPERATOR TO MOMENTARILY OPEN DOOR. FREE EGRESS AT ALL TIMES.

DOOR CONTACT MONITORS DOOR POSITION. RX SWITCH BYPASSES DOOR CONTACT WHILE EGRESSING.

NEW CONSTRUCTION FOR:
DOW GARDENS WELCOME CENTER
MIDLAND, MICHIGAN

PROJECT NO. 2022022

HARDWARE GROUP NO. 16

For use on Door #(s):
116.1

Provide each opening with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	112XY EPT	710	IVE
1	EA	POWER TRANSFER	EPT10	695	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-98-NL-OP	313	VON
1	EA	FSIC RIM HOUSING	20-079	643e	SCH
1	EA	FSIC CORE	23-030	613	SCH
1	EA	LONG DOOR PULL	9264F 72"	BLK	IVE
1	EA	OH STOP	100S	643E/7 16	GLY
1	EA	SURFACE CLOSER	4021	695	LCN
1	EA	MOUNTING PLATE	4020-18G	695	LCN
1	EA	WEATHERSTRIPPING/GA SKETING	BY DOOR/FRAME MANUFACTURER		
1	EA	DOOR SWEEP	8198D	D	ZER
1	EA	THRESHOLD	655A-223	A	ZER
1	EA	MULTITECH READER	MTB11/MTB15 - BY ACCESS CONTROL PROVIDER	BLK	SCE
1	EA	DOOR CONTACT	679-05 WD/HM AS REQ'D	BLK	SCE
1	EA	POWER SUPPLY	PS902	LGR	SCE

DOOR NORMALLY CLOSED AND LOCKED. PRESENTING VALID CREDENTIAL TO READER
MOMENTARILY RETRACTS PANIC DEVICE LATCH ALLOWING ENTRY. FREE EGRESS AT
ALL TIMES.

DOOR CONTACT MONITORS DOOR POSITION. RX SWITCH BYPASSES DOOR CONTACT
WHILE EGRESSING.

NEW CONSTRUCTION FOR:
DOW GARDENS WELCOME CENTER
MIDLAND, MICHIGAN

PROJECT NO. 2022022

HARDWARE GROUP NO. 17

For use on Door #(s):

117A.1

Provide each opening with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	224XY	628	IVE
1	EA	PANIC HARDWARE	LD-98-EO	626	VON
1	EA	SURFACE CLOSER	4111 CUSH	695	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142AA	AA	ZER
1	SET	GASKETING	429AA-S	AA	ZER
1	EA	DOOR SWEEP	8198AA	AA	ZER
1	EA	THRESHOLD	655A-223	A	ZER

EXIT ONLY

NEW CONSTRUCTION FOR:
DOW GARDENS WELCOME CENTER
MIDLAND, MICHIGAN

PROJECT NO. 2022022

HARDWARE GROUP NO. 18

For use on Door #(s):
100.2

Provide each opening with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	CONT. HINGE	112XY EPT	710	IVE
2	EA	POWER TRANSFER	EPT10	695	VON
1	EA	REMOVABLE MULLION	KR4954 STAB	695	VON
2	EA	ELEC PANIC HARDWARE	RX-QEL-98-EO	313	VON
1	EA	FSIC MORTISE HOUSING	20-059 (BLOCKING RINGS & CAM AS REQ)	643e	SCH
1	EA	FSIC CORE	23-030	613	SCH
2	EA	LONG DOOR PULL	9264F 72"	BLK	IVE
2	EA	OH STOP	100S	643E/7 16	GLY
2	EA	SURFACE CLOSER	4021	695	LCN
2	EA	MOUNTING PLATE	4020-18G	695	LCN
1	EA	MULLION SEAL	8780NBK PSA	BK	ZER
1	EA	WEATHERSTRIPPING/GA SKETING	BY DOOR/FRAME MANUFACTURER		
2	EA	DOOR SWEEP	8198D	D	ZER
1	EA	THRESHOLD	655A-223	A	ZER
2	EA	DOOR CONTACT	679-05 WD/HM AS REQ'D	BLK	SCE
1	EA	POWER SUPPLY	PS902 900-2RS	LGR	SCE

UNLOCKED HOURS:

PANIC DEVICE(S) ELECTRICALLY DOGGED (I.E. IN PUSH/PULL MODE). PANIC DEVICE(S)
LATCH AND LOCK WITH LOSS OF POWER.

LOCKED HOURS:

DOOR NORMALLY CLOSED AND LOCKED. FREE EGRESS AT ALL TIMES.

DOOR CONTACT MONITORS DOOR POSITION. RX SWITCH BYPASSES DOOR CONTACT
WHILE EGRESSING.

NEW CONSTRUCTION FOR:
DOW GARDENS WELCOME CENTER
MIDLAND, MICHIGAN

PROJECT NO. 2022022

HARDWARE GROUP NO. 19

For use on Door #(s):
103.3

Provide each opening with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	CONT. HINGE	112XY EPT	710	IVE
2	EA	POWER TRANSFER	EPT10	695	VON
1	EA	REMOVABLE MULLION	KR4954 STAB	695	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-98-NL-OP	313	VON
1	EA	FSIC MORTISE HOUSING	20-059 (BLOCKING RINGS & CAM AS REQ)	643e	SCH
1	EA	FSIC RIM HOUSING	20-079	643e	SCH
2	EA	FSIC CORE	23-030	613	SCH
2	EA	LONG DOOR PULL	9264F 72"	BLK	IVE
2	EA	OH STOP	100S	643E/7 16	GLY
2	EA	SURFACE CLOSER	4021	695	LCN
2	EA	MOUNTING PLATE	4020-18G	695	LCN
1	EA	MULLION SEAL	8780NBK PSA	BK	ZER
1	EA	WEATHERSTRIPPING/GA SKETING	BY DOOR/FRAME MANUFACTURER		
2	EA	DOOR SWEEP	8198D	D	ZER
1	EA	THRESHOLD	655A-223	A	ZER
1	EA	MULTITECH READER	MTB11/MTB15 - BY ACCESS CONTROL PROVIDER	BLK	SCE
2	EA	DOOR CONTACT	679-05 WD/HM AS REQ'D	BLK	SCE
1	EA	POWER SUPPLY	PS902 900-2RS	LGR	SCE

DOORS NORMALLY CLOSED AND LOCKED. PRESENTING VALID CREDENTIAL TO READER
MOMENTARILY RETRACTS PANIC DEVICE LATCH ALLOWING ENTRY. FREE EGRESS AT
ALL TIMES.

DOOR CONTACT MONITORS DOOR POSITION. RX SWITCH BYPASSES DOOR CONTACT
WHILE EGRESSING.

NEW CONSTRUCTION FOR:
DOW GARDENS WELCOME CENTER
MIDLAND, MICHIGAN

PROJECT NO. 2022022

HARDWARE GROUP NO. 20

For use on Door #(s):

101.2 103.2

Provide each opening with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	CONT. HINGE	112XY	710	IVE
2	EA	DUMMY PUSH BAR	350	313	VON
2	EA	LONG DOOR PULL	9264F 72"	BLK	IVE
2	EA	OH STOP	100S	643E/7 16	GLY
2	EA	SURFACE CLOSER	4021	695	LCN
2	EA	MOUNTING PLATE	4020-18G	695	LCN
1	EA	WEATHERSTRIPPING/GA SKETING	BY DOOR/FRAME MANUFACTURER		

HARDWARE GROUP NO. 21

For use on Door #(s):

103.1

Provide each opening with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	CONT. HINGE	112XY	710	IVE
2	EA	DUMMY PUSH BAR	350	313	VON
2	EA	LONG DOOR PULL	9264F 72"	BLK	IVE
1	EA	OH STOP	100S	643E/7 16	GLY
1	EA	OH STOP	100SE	643E/7 16	GLY
1	EA	SURFACE CLOSER	4021	695	LCN
1	EA	SURF. AUTO OPERATOR	4640	695	LCN
1	EA	MOUNTING PLATE	4020-18G	695	LCN
2	EA	ACTUATOR, JAMB MOUNT	8310-818T	630	LCN
2	EA	MOUNT BOX	8310-819F		LCN
1	EA	WEATHERSTRIPPING/GA SKETING	BY DOOR/FRAME MANUFACTURER		

NEW CONSTRUCTION FOR:
 DOW GARDENS WELCOME CENTER
 MIDLAND, MICHIGAN

PROJECT NO. 2022022

HARDWARE GROUP NO. 22

For use on Door #(s):
 101.1

Provide each opening with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	CONT. HINGE	112XY	710	IVE
2	EA	DUMMY PUSH BAR	350	313	VON
2	EA	LONG DOOR PULL	9264F 72"	BLK	IVE
1	EA	OH STOP	100S	643E/7 16	GLY
1	EA	SURFACE CLOSER	4021	695	LCN
1	EA	SURF. AUTO OPERATOR	4640	695	LCN
1	EA	MOUNTING PLATE	4020-18G	695	LCN
2	EA	WALL MOUNT PUSHPLATE	8310-852T	630	LCN
2	EA	MOUNT BOX	8310-869F		LCN
1	EA	WALL STOP	WS406/407CVX	630	IVE
1	EA	WEATHERSTRIPPING/GA SKETING	BY DOOR/FRAME MANUFACTURER		

HARDWARE GROUP NO. 23

For use on Door #(s):
 117.1 117A.2

Provide each opening with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	WOOD DOORS PER 08- 1614	(PROVIDED WITH SLIDING DOOR SYSTEM)		VTI
1	EA	SLIDING DOOR SERIES	OFFICESLIDE SYSTEM , SECTION 08 34 00		ADS
1	EA	SELF-LATCHING OFFICE LOCK	AD6450-L L17	626	ADS
1	EA	DUAL SOFT CLOSE DAMPERS	2KIT DUAL ADS 220LB		ADS
1	EA	FSIC CYLINDER HOUSING	AS REQUIRED	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	PERIMETER DOOR SEALS (HEAD/JAMB)	(PROVIDED WITH SLIDING DOOR SYSTEM)	GRY	ADS
1	EA	STILE POCKET GASKETING	(PROVIDED WITH SLIDING DOOR SYSTEM)	GRY	ADS
1	EA	Acoustic Door Bottom	(PROVIDED WITH SLIDING DOOR SYSTEM)		ADS

NEW CONSTRUCTION FOR:
DOW GARDENS WELCOME CENTER
MIDLAND, MICHIGAN

PROJECT NO. 2022022

HARDWARE GROUP NO. 24

For use on Door #(s):

102.2

Provide each opening with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	ELEC PANIC HARDWARE	RX-98-EO-ALK	626	VON
1	EA	FSIC MORTISE HOUSING	20-059 (BLOCKING RINGS & CAM AS REQ)	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	SURFACE CLOSER	4111 EDA	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
3	EA	SILENCER	SR64/SR65 AS REQ'D	GRY	IVE
1	EA	POWER SUPPLY	PS902	LGR	SCE

WHEN TOUCHBAR OF EXIT DEVICE IS DEPRESSED, AN INTERNAL HORN SOUNDS
INDICATING UNAUTHORIZED USE OF THE OPENING. ALARM CAN BE ARMED OR DISARMED
BY KEYED CYLINDER.

HARDWARE GROUP NO. 25

For use on Door #(s):

118.1 119.5

Provide each opening with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
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ALL HARDWARE BY MANUFACTURER

HARDWARE GROUP NO. 26

For use on Door #(s):

103.4

Provide each opening with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
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CASED OPENING - NO HARDWARE REQUIRED

HARDWARE GROUP NO. 27

For use on Door #(s):

119.2 120.2

Provide each opening with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	112XY	710	IVE
1	EA	PANIC HARDWARE	CD-98-NL-OP-110MD	313	VON
1	EA	FSIC MORTISE HOUSING	20-059 (BLOCKING RINGS & CAM AS REQ)	643e	SCH
1	EA	FSIC RIM HOUSING	20-079	643e	SCH
2	EA	FSIC CORE	23-030	613	SCH
1	EA	LONG DOOR PULL	9264F 72"	BLK	IVE
1	EA	OH STOP	100S	643E/7 16	GLY
1	EA	SURFACE CLOSER	4021	695	LCN
1	EA	MOUNTING PLATE	4020-18G	695	LCN
1	EA	WEATHERSTRIPPING/GA SKETING	BY DOOR/FRAME MANUFACTURER		
1	EA	DOOR SWEEP	8198D	D	ZER
1	EA	THRESHOLD	655A-223	A	ZER

HARDWARE GROUP NO. 28

For use on Door #(s):

103A.2

Provide each opening with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	CONT. HINGE	112XY	710	IVE
1	EA	REMOVABLE MULLION	KR4954 STAB	695	VON
2	EA	PANIC HARDWARE	CD-98-EO	313	VON
3	EA	FSIC MORTISE HOUSING	20-059 (BLOCKING RINGS & CAM AS REQ)	643e	SCH
3	EA	FSIC CORE	23-030	613	SCH
2	EA	LONG DOOR PULL	9264F 72"	BLK	IVE
2	EA	OH STOP	100S	643E/7 16	GLY
2	EA	SURFACE CLOSER	4021	695	LCN
2	EA	MOUNTING PLATE	4020-18G	695	LCN
1	EA	MULLION SEAL	8780NBK PSA	BK	ZER
1	EA	WEATHERSTRIPPING/GA SKETING	BY DOOR/FRAME MANUFACTURER		
2	EA	DOOR SWEEP	8198D	D	ZER
1	EA	THRESHOLD	655A-223	A	ZER

NEW CONSTRUCTION FOR:
DOW GARDENS WELCOME CENTER
MIDLAND, MICHIGAN

PROJECT NO. 2022022

HARDWARE GROUP NO. 29

For use on Door #(s):

103A.1 132.1

Provide each opening with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	112XY	710	IVE
1	EA	CONT. HINGE	112XY EPT	710	IVE
1	EA	POWER TRANSFER	EPT10	695	VON
1	EA	REMOVABLE MULLION	KR4954 STAB	695	VON
1	EA	PANIC HARDWARE	CD-98-EO	313	VON
1	EA	ELEC PANIC HARDWARE	CD-LX-98-NL-OP-110MD	313	VON
3	EA	FSIC MORTISE HOUSING	20-059 (BLOCKING RINGS & CAM AS REQ)	643e	SCH
1	EA	FSIC RIM HOUSING	20-079	643e	SCH
4	EA	FSIC CORE	23-030	613	SCH
2	EA	LONG DOOR PULL	9264F 72"	BLK	IVE
1	EA	OH STOP	100S	643E/7 16	GLY
1	EA	OH STOP	100SE	643E/7 16	GLY
1	EA	SURFACE CLOSER	4021	695	LCN
1	EA	SURF. AUTO OPERATOR	4640	695	LCN
1	EA	MOUNTING PLATE	4020-18G	695	LCN
1	EA	ACTUATOR, JAMB MOUNT	8310-818T	630	LCN
1	EA	MOUNT BOX	8310-819F		LCN
1	EA	ACTUATOR, TOUCH	8310-836T	630	LCN
1	EA	MULLION SEAL	8780NBK PSA	BK	ZER
1	EA	WEATHERSTRIPPING/GA SKETING	BY DOOR/FRAME MANUFACTURER		
2	EA	DOOR SWEEP	8198D	D	ZER
1	EA	THRESHOLD	655A-223	A	ZER

UNLOCKED HOURS:

PANIC DEVICE(S) MECHANICALLY DOGGED (I.E. IN PUSH/PULL MODE) AND BOTH AUTO OPERATOR ACTUATORS ACTIVE. PUSHING EITHER ACTUATOR SIGNALS AUTOMATIC OPERATOR TO MOMENTARILY OPEN THE DOOR.

LOCKED HOURS:

DOOR NORMALLY CLOSED AND LOCKED. FREE EGRESS AT ALL TIMES.

LATCH MONITORING SWITCH (LX) TOGGLES ACTUATORS ENABLED/DISABLED.

END OF SECTION

DOOR HARDWARE

087100-40

SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Glass for windows, doors, interior borrowed lites and storefront framing.
2. Glazing sealants and accessories.

1.2 RELATED SECTIONS

A. 088700 - WINDOW FILM

1.3 COORDINATION

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches (300 mm) square.
- C. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use the same designations indicated on Drawings.
- D. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Preconstruction adhesion and compatibility test report.

1.6 QUALITY ASSURANCE

- A. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

1.7 PRECONSTRUCTION TESTING

- A. Preconstruction Adhesion and Compatibility Testing: Test each glass product, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.
1. Testing is not required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.

1.8 WARRANTY

- A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.
 - 1. Warranty Period: 10 years from date of Substantial Completion.
- B. Manufacturer's Special Warranty for Laminated Glass: Manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.
 - 1. Warranty Period: Five years from date of Substantial Completion.
- C. Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Guardian Glass; SunGuard.
 - 2. Vitro.
 - 3. Substitutions: See Section 012500 - Substitution Procedures.

2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, registered in the State of Michigan to design glazing.
- B. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined according to the International Building Code and ASTM E 1300.
 - 1. Design Wind Pressures: per Michigan Building Code.
 - 2. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.
- C. Safety Glazing: Where safety glazing is required by the building codes, provide glazing that complies with 16 CFR 1201, Category II.
- D. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:

1. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F (W/sq. m x K).
2. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
3. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.3 GLASS PRODUCTS, GENERAL

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 1. GANA Publications: "Laminated Glazing Reference Manual" and "Glazing Manual."
 2. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR A7, "Sloped Glazing Guidelines."
 3. IGMA Publication for Sloped Glazing: IGMA TB-3001, "Guidelines for Sloped Glazing."
 4. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- B. Safety Glazing Labeling: Where safety glazing is required by the building codes, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction or manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.
- D. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than the thickness indicated.
- E. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.

2.4 GLASS PRODUCTS

- A. Clear Annealed Float Glass: ASTM C 1036, Type I, Class 1 (clear), Quality-Q3.
- B. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
- C. Heat-Strengthened Float Glass: ASTM C 1048, Kind HS (heat strengthened), Type I, Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

2.5 LAMINATED GLASS

- A. Laminated Glass: ASTM C 1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.
 1. Construction: Laminate glass with polyvinyl butyral interlayer or cast-in-place and cured-transparent-resin interlayer to comply with interlayer manufacturer's written instructions.

2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
3. Interlayer Color: Clear unless otherwise indicated.

2.6 INSULATING GLASS

- A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190.
1. Sealing System: Dual seals.
 2. Perimeter Spacer: Manufacturer's standard warm-edge spacer material and construction.

2.7 GLAZING SEALANTS

- A. General:
1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
 2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
 3. Sealant shall have a VOC content of 250 g/L or less.
 4. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.
- B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use NT.
1. Available Products:
 - a. GE Silicones; Silglaze II SCS2800
 - b. Tremco; Tremsil 600
 - c. Dow Corning Corporation; 795
 - d. Substitutions: See Section 012500 - Substitution Procedures.

2.8 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
1. AAMA 804.3 tape, where indicated.
 2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
 3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
- B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
 2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.9 MISCELLANEOUS GLAZING MATERIALS

- A. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- B. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- C. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- D. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- E. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.
- F. Perimeter Insulation for Fire-Resistive Glazing: Product that is approved by testing agency that listed and labeled fire-resistant glazing product with which it is used for application and fire-protection rating indicated.

PART 3 - EXECUTION

3.1 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.
- C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- F. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).
- G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

3.2 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Apply heel bead of elastomeric sealant.
- F. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- G. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.3 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- E. Install gaskets so they protrude past face of glazing stops.

3.4 SEALANT GLAZING (WET)

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.5 CLEANING AND PROTECTION

- A. Immediately after installation remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.
 - 1. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.
- C. Remove and replace glass that is damaged during construction period.

3.6 MONOLITHIC GLASS SCHEDULE

- A. Glass Type GL-A: Clear fully tempered float glass at all interior non-fire rated location except as noted.
 - 1. Minimum Thickness: 6 mm.
 - 2. Safety glazing required.
 - 3. Substitutions: See Section 012500 - Substitution Procedures.
 - 4. Provide Frosted film at locations indicated on drawings.

3.7 INSULATING GLASS SCHEDULE

- A. Glass Type GL-1: Low-E-coated, clear insulating glass at all exterior locations unless indicated otherwise. Provide laminated glass at hazardous locations requiring safety glazing as indicated on Drawings.
1. Basis-of-Design Product, provide one of the following:
 - a. Guardian Glass; SunGuard SNX 62/27
 - b. Vitro (PPG); Solarban 70 XL
 - c. Substitutions: See Section 012500 - Substitution Procedures.
 2. Overall Unit Thickness: 1 inch (25 mm).
 3. Minimum Thickness of Each Glass Lite: 6 mm.
 4. Outdoor Lite: Heat-strengthened float glass.
 - a. Provide clear laminated glass with two plies of tempered float glass where indicated on Drawings.
 - 1) Minimum Thickness of Each Glass Ply: 3 mm.
 5. Interspace Content: Argon.
 6. Indoor Lite: Heat-strengthened float glass.
 - a. Provide fully tempered float glass where indicated on Drawings.
 7. Low-E Coating: Sputtered on second surface.
 8. Winter Nighttime U-Factor: .24 maximum.
 9. Summer Daytime U-Factor: .21 maximum.
 10. Visible Light Transmittance: 61 percent minimum.
 11. Solar Heat Gain Coefficient: .27 maximum.
 12. Safety glazing required.
 13. Provide Frosted film at locations indicated on drawings.
- B. Glass Type GL-2: Low-E-coated, clear insulating glass with UV coating at exterior locations as indicated on drawings. Provide laminated glass at hazardous locations requiring safety glazing as indicated on Drawings.
1. Basis-of-Design Product, provide one of the following:
 - a. Guardian Glass; Bird1st UV SNX 62/27
 - b. Substitutions: See Section 012500 - Substitution Procedures.
 2. Overall Unit Thickness: 1 inch (25 mm).
 3. Minimum Thickness of Each Glass Lite: 6 mm.
 4. Outdoor Lite: Heat-strengthened float glass.
 - a. Provide clear laminated glass with two plies of tempered float glass where indicated on Drawings.
 - 1) Minimum Thickness of Each Glass Ply: 3 mm.
 5. Interspace Content: Argon.
 6. Indoor Lite: Heat-strengthened float glass.
 - a. Provide fully tempered float glass where indicated on Drawings.
 7. Low-E Coating: Sputtered on second surface.
 8. Winter Nighttime U-Factor: .28 maximum.
 9. Summer Daytime U-Factor: .26 maximum.
 10. Visible Light Transmittance: 60 percent minimum.
 11. Solar Heat Gain Coefficient: .27 maximum.
 12. Safety glazing required.
- C. Glass Type GL-3: Low-E-coated, SatinDeco insulating glass with UV coating at exterior locations as indicated on drawings. Provide laminated glass at hazardous locations requiring safety glazing as indicated on Drawings.
1. Basis-of-Design Product, provide one of the following:
 - a. Guardian Glass; Bird1st UV SNX 62/27

- b. Substitutions: See Section 012500 - Substitution Procedures.
- 2. Overall Unit Thickness: 1 inch (25 mm).
- 3. Minimum Thickness of Each Glass Lite: 6 mm.
- 4. Outdoor Lite: Heat-strengthened float glass.
 - a. Provide clear laminated glass with two plies of tempered float glass where indicated on Drawings.
 - 1) Minimum Thickness of Each Glass Ply: 3 mm.
- 5. Interspace Content: Argon.
- 6. Indoor Lite: Heat-strengthened float glass.
 - a. Provide fully tempered float glass where indicated on Drawings.
- 7. Low-E Coating: Sputtered on second surface.
- 8. Acid Etch Coating: SatinDeco on second surface.
- 9. Winter Nighttime U-Factor: .28 maximum.
- 10. Summer Daytime U-Factor: .26 maximum.
- 11. Visible Light Transmittance: 60 percent minimum.
- 12. Solar Heat Gain Coefficient: .27 maximum.
- 13. Safety glazing required.

END OF SECTION 088000

SECTION 088300 - MIRRORS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes the following types of silvered flat glass mirrors (SP-01) (Ref. Specialties Schedule):
 - 1. Annealed monolithic glass mirrors.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include mirror elevations, edge details, mirror hardware, and attachment details.
- C. Samples: For each type of the following:
 - 1. Mirrors: 12 x 12 samples with bevel edge

1.3 INFORMATIONAL SUBMITTALS

- A. Preconstruction test report.
- B. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For mirrors to include in maintenance manuals.

1.5 PRECONSTRUCTION TESTING

- A. Preconstruction Mirror Mastic Compatibility Test: Submit mirror mastic products to mirror manufacturer for testing to determine compatibility of mastic with mirror backing.

1.6 WARRANTY

- A. Special Warranty: Manufacturer agrees to replace mirrors that deteriorate within specified warranty period. Deterioration of mirrors is defined as defects developed from normal use that are not attributed to mirror breakage or to maintaining and cleaning mirrors contrary to manufacturer's written instructions. Defects include discoloration, black spots, and clouding of the silver film.
 - 1. Warranty Period: 10 years from date of Substantial Completion, manufacture.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Avalon Glass and Mirror Company.
 - 2. Binswanger Mirror; a division of Vitro America, Inc.
 - 3. D & W Incorporated.
 - 4. Donisi Mirror Company.

5. Gardner Glass, Inc.
6. Gilded Mirrors, Inc.
7. Glasswerks LA, Inc.
8. Guardian Glass; SunGuard.
9. Head West.
10. Independent Mirror Industries, Inc.
11. Lenoir Mirror Company.
12. National Glass Industries.
13. Stroupe Mirror Co., Inc.
14. Sunshine Mirror.
15. Trulite Glass & Aluminum Solutions, LLC.
16. Virginia Mirror Company, Inc.
17. Walker Glass Co., Ltd.
18. Substitutions: See Section 012500 - Substitution Procedures.

2.2 SILVERED FLAT GLASS MIRRORS

- A. Mirrors, General: ASTM C 1503; manufactured using copper-free, low-lead mirror coating process.
- B. Annealed Monolithic Glass Mirrors: Mirror Select Quality, clear.
 1. Nominal Thickness: 6.0 mm.

2.3 MISCELLANEOUS MATERIALS

- A. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- B. Edge Sealer: Coating approved by mirror manufacturer.
- C. Mirror Mastic: An adhesive setting compound, asbestos-free, produced specifically for setting mirrors.
 1. Adhesives shall have a VOC content of 70 g/L or less.
- D. Film Backing for Safety Mirrors: Film backing and pressure-sensitive adhesive; both compatible with mirror backing paint as certified by mirror manufacturer.

2.4 MIRROR HARDWARE

- A. Mirror Bottom Clips: Stainless Steel mirror clip with anochrome finish.
- B. Mirror Top Clips: Manufacturer; C.R. Laurence, Inc. Stainless Steel mirror clip with anochrome finish.
- C. Fasteners: Fabricated of same basic metal and alloy as fastened metal and matching it in finished color and texture where fasteners are exposed.
- D. Anchors and Inserts: Provide devices as required for mirror hardware installation.

2.5 FABRICATION

- A. Mirror Edge Treatment: 1/2" bevel. Seal edges of mirrors with edge sealer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, over which mirrors are to be mounted, with Installer present, for compliance with installation tolerances, substrate preparation, and other conditions affecting performance of the Work.

- B. Proceed with installation only after unsatisfactory conditions have been corrected and surfaces are dry.

3.2 PREPARATION

- A. Comply with mastic manufacturer's written installation instructions for preparation of substrates, including coating substrates with mastic manufacturer's special bond coating where applicable.

3.3 INSTALLATION

- A. General: Install mirrors to comply with mirror manufacturer's written instructions and with referenced GANA publications. Mount mirrors accurately in place in a manner that avoids distorting reflected images.
- B. Install mirrors with mastic and mirror hardware. Attach mirror hardware securely to mounting surfaces with mechanical fasteners installed with anchors or inserts as applicable. Install fasteners so heads do not impose point loads on backs of mirrors.
 - 1. Apply mastic to comply with mastic manufacturer's written instructions for coverage and to allow air circulation between back of mirrors and face of mounting surface.
- C. Clean exposed surface of mirrors not more than four days before date scheduled for inspections that establish date of Substantial Completion. Clean mirrors as recommended in writing by mirror manufacturer.

END OF SECTION 088300

SECTION 088700 - WINDOW FILM

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Architectural Window Film:
 - 1. Single patterned film.
 - 2. Transparent Colored PVC Film

1.2 RELATED SECTIONS

- A. Section 08500 - Windows; windows to receive architectural window film.
- B. Section 08600 - Skylights; glass skylights to receive architectural window film.
- C. Section 08800 - Glazing; general glazing applications to receive architectural window film.
- D. Section 08900 - Glazed Curtain Walls; curtain walls to receive architectural window film.

1.3 REFERENCES

- A. ASHRAE - American Society for Heating, Refrigeration, and Air Conditioning Engineers; Handbook of Fundamentals.
- B. ASTM International (ASTM):
 - 1. ASTM E 84 - Standard Method of Test for Surface Burning Characteristics of Building Materials.
 - 2. ASTM E 308 - Standard Recommended Practice for Spectrophotometry and Description of Color in CIE 1931 System.
 - 3. ASTM E 903 - Standard Methods of Test for Solar Absorbance, Reflectance and Transmittance of Materials Using Integrating Spheres.
- C. NFRC 100/200 (Formerly ASTM E903) - Standard Methods of Test for Solar Absorbance, Reflectance and Transmittance of Materials Using Integrating Spheres.

1.4 PERFORMANCE REQUIREMENTS

- A. Flammability: Surface burning characteristics when tested in accordance ASTM E 84, demonstrating film applied to glass rated Class A for Interior Use:
 - 1. Flame Spread Index: no greater than 25.
 - 2. Smoke Developed Index: no greater than 55.

1.5 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Product Data: Manufacturer's current technical literature on each product to be used, including:
 - 1. Manufacturer's Data Sheets.
 - 2. Preparation instructions and recommendations.
 - 3. Storage and handling requirements and recommendations.
 - 4. Installation methods.
- C. Verification Samples: For each film specified, two samples representing actual film color and

pattern.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: All primary products specified in this section will be supplied by a single manufacturer with a minimum of ten years experience.
 - 1. Provide documentation that the adhesive used on the specified films is a Pressure Sensitive Adhesive (PSA).
- B. Installer Qualifications: All products listed in this section are to be installed by a single installer with a minimum of five years demonstrated experience in installing products of the same type and scope as specified.
 - 1. Provide documentation that the installer is authorized by the Manufacturer to perform Work specified in this section.
 - 2. Provide a commercial building reference list of 5 properties where the installer has applied window film. This list will include the following information:
 - a. Name of building.
 - b. The name and telephone number of a management contact.
 - c. Type of glass.
 - d. Type of film and/or film attachment system.
 - e. Amount of film and/or film attachment system installed.
 - f. Date of completion.
- C. 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.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Follow Manufacturer's instructions for storage and handling.
- B. Store products in manufacturer's unopened packaging until ready for installation.
- C. Store and dispose of hazardous materials, and materials contaminated by hazardous materials, in accordance with requirements of local authorities having jurisdiction.

1.8 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

1.9 WARRANTY

- A. At project closeout, provide to Owner or Owners Representative an executed current copy of the manufacturer's standard limited warranty against manufacturing defect, outlining its terms, conditions, and exclusions from coverage.
- B. In order to validate warranty, installation must be performed by an Authorized 3M dealer and according to Manufacturer's installation instructions. Verification of Authorized 3M dealer can be confirmed by submission of active 3M dealer code number.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturer: 3M Commercial Solutions, which is located at: 3M Center Bldg. 223; St. Paul, MN 55144-1000; Toll Free Tel: 888-650-3497; Tel: 651-737-1081; Fax: 651-737-8241; Email:[request info \(apeters2@mmm.com\)](mailto:request info (apeters2@mmm.com));
Web:http://www.3m.com/3M/en_US/architectural-design-us/?utm_medium=redirect&utm_source=vanity-url&utm_campaign=www.3M.com/AMD|http://www.3m.com/3M/en_US/building-window-solutions-us
- B. Substitutions: See Section 012500 Substitutions Procedures.

2.2 ARCHITECTURAL FINISH FILMS

- A. Architectural Finish Films: 3M CRYSTAL Glass Finishes as manufactured by 3M Company - Commercial Solutions.
1. Material Properties:
 - a. General: Glass finishes field-applied application to glass or plastic material as visual opaque or decorative film.
 - b. Film: Vinyl.
 - c. Option to Electrocut (by other than Manufacturer).
 - d. Adhesive: Acrylic, Pressure Sensitive, Permanent.
 - e. Liner: Silicone-coated Polyester.
 - f. Thickness (Film and Adhesive without Liner):
 - 1) Frosted - 4.7 mils (120 microns).
 - g. Fire Performance: Surface burning characteristics when tested in accordance with ASTM E84, Class A:
 - 1) Flame Spread: 25 maximum.
 - 2) Smoke Developed: 450 maximum.
 2. Optical Performance:
 - a. CRYSTAL Frosted Decorative / Privacy Glazing Film:
 - 1) Ultraviolet Transmittance (ASTM E 903): 20 percent.
 - 2) Visible Light Transmittance (ASTM E 903, ASTM E308): 72 percent.
 - 3) Visible Light Reflectance (ASTM E 903): 12 percent.
 - 4) Solar Heat Transmittance: 64 percent.
 - 5) Solar Heat Reflectance: 10 percent.
 - 6) Shading Coefficient at 90 Degrees (Normal Incidence) (ASTM E 903): 0.82.
- B. Architectural Finish Films: ORACAL 8300 TRANSPARENT CALENDERED as manufactured by ORAFOL Americas.
- C. Material Properties:
1. General: Glass finishes field-applied application to glass or plastic material as visual opaque or decorative film.
 2. Film: PVC Film.
 3. Option to Electrocut (by other than Manufacturer).
 4. Adhesive: Acrylic, Pressure Sensitive, Permanent.
 5. Liner: Silicone-coated Polyester.
 6. Thickness (Film and Adhesive without Liner):
 - a. 3 mils.
 - b. Solar Heat Reflectance: 10 percent.
 - c. Shading Coefficient at 90 Degrees (Normal Incidence) (ASTM E 903): 0.82.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Film Examination:
 - 1. If preparation of glass surfaces is the responsibility of another installer, notify Architect in writing of deviations from manufacturer's recommended installation tolerances and conditions.
 - a. Glass surfaces receiving new film should first be examined to verify that they are free from defects and imperfections, which will affect the final appearance.
 - 2. Do not proceed with installation until glass surfaces have been properly prepared and deviations from manufacturer's recommended tolerances are corrected. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result under the project conditions.
 - 3. Commencement of installation constitutes acceptance of conditions.

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. Refer to Manufacturer's installation instructions for methods of preparation for Impact Protection Adhesive or Impact Protection Profile film attachment systems.

3.3 INSTALLATION

- A. Film Installation, General:
 - 1. Install in accordance with manufacturer's instructions.
 - 2. Cut film edges neatly and square at a uniform distance of 1/8 inch (3 mm) to 1/16 inch (1.5 mm) of window sealant. Use new blade tips after 3 to 4 cuts.
 - 3. Spray the slip solution, composed of one capful of baby shampoo or dishwashing liquid to 1 gallon of water, on window glass and adhesive to facilitate proper positioning of film.
 - 4. Apply film to glass and lightly spray film with slip solution.
 - 5. Squeegee from top to bottom of window. Spray slip solution to film and squeegee a second time.
 - 6. Bump film edge with lint-free towel wrapped around edge of a 5-way tool.
 - 7. Upon completion of film application, allow 30 days for moisture from film installation to dry thoroughly, and to allow film to dry flat with no moisture dimples when viewed under normal viewing conditions.
 - 8. If completing an exterior application, check with the manufacturer as to whether edge sealing is required.

3.4 CLEANING AND PROTECTION

- A. Remove left over material and debris from Work area. Use necessary means to protect film before, during, and after installation.
- B. Touch-up, repair or replace damaged products before Substantial Completion.
- C. After application of film, wash film using common window cleaning solutions, including ammonia solutions, 30 days after application. Do not use abrasive type cleaning agents and bristle brushes to avoid scratching film. Use synthetic sponges or soft cloths.

NEW CONSTRUCTION FOR:
DOW GARDENS WELCOME CENTER
MIDLAND, MICHIGAN

PROJECT NO. 2022022

END OF SECTION 08870

SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Non-load-bearing steel framing systems for interior gypsum board assemblies.
 - 2. Suspension systems for interior gypsum ceilings and soffits.

1.2 SUBMITTALS

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: Provide materials and construction identical to those tested according to ASTM E 119.
- B. STC-Rated Assemblies: Provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413.

2.2 FRAMING SYSTEMS

- A. Steel Studs and Runners: ASTM C 645. Use steel studs and runners of actual thickness indicated.
 - 1. Minimum Base-Metal Thickness: 20 gauge (0.033 inch (0.84 mm)).
 - 2. Depth: As indicated on Drawings.
- B. Slip-Type Head Joints: Where indicated, provide the following in thickness not less than indicated for studs and in width to accommodate depth of studs:
 - 1. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes due to deflection of structure above.
 - a. Products: Subject to compliance with requirements, provide one of the following. Substitutions: See Section 012500 - Product Requirements:
 - 1) Dietrich Metal Framing; SLP-TRK Slotted Deflection Track.
 - 2) MBA Building Supplies; FlatSteel Deflection Track or Slotted Deflecto Track.
 - 3) Steel Network Inc. (The); VertiClip SLD or VertiTrack VTD Series.
 - 4) Superior Metal Trim; Superior Flex Track System (SFT).
 - 5) Telling Industries; Vertical Slip Track or Vertical Slip Track II.
- C. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
 - 1. Minimum Base-Metal Thickness: 0.018 inch (0.45 mm).
- D. Cold-Rolled Channel Bridging: Steel, 0.053-inch (1.34-mm) minimum base-metal thickness, with minimum 1/2-inch- (13-mm-) wide flanges.
 - 1. Depth: 1-1/2 inches (38 mm).
 - 2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches (38 by 38 mm), 0.068-inch- (1.72-mm-) thick, galvanized steel.
- E. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
 - 1. Minimum Base-Metal Thickness: 0.033 inch (0.84 mm).
 - 2. Depth: 7/8 inch (22.2 mm) and 1-1/2 inches (38.1 mm).

- F. Cold-Rolled Furring Channels: 0.053-inch (1.34-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm) wide flanges.
 - 1. Depth: 3/4 inch (19 mm).
 - 2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum uncoated-steel thickness of 0.033 inch (0.8 mm).
 - 3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.
- G. Z-Shaped Furring: With slotted or non-slotted web, face flange of 1-1/4 inches (31.8 mm), wall attachment flange of 7/8 inch (22 mm), minimum uncoated-metal thickness of 0.018 inch (0.45 mm), and depth required for thickness indicated.

2.3 SUSPENSION SYSTEMS

- A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.
- B. Hanger Attachments to Concrete:
 - 1. Anchors: Capable of sustaining a load equal to 5 times that imposed as determined by ASTM E 488.
 - a. Type: Post-installed, chemical anchor or post-installed, expansion anchor.
 - 2. Powder-Actuated Fasteners: Capable of sustaining, a load equal to 10 times that imposed as determined by ASTM E 1190.
- C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch (4.12 mm) in diameter.
- D. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.053 inch (1.34 mm) and minimum 1/2-inch- (13-mm-) wide flanges.
 - 1. Depth: 2 inches (51 mm).
- E. Furring Channels (Furring Members):
 - 1. Cold-Rolled Channels: 0.053-inch (1.34-mm) uncoated-steel thickness, with minimum 1/2-inch (13 mm) wide flanges, 3/4 inch (19 mm) deep.
 - 2. Steel Studs and Runners: ASTM C 645. Use either steel studs and runners or dimpled steel studs and runners of equivalent minimum base-metal thickness.
 - a. Minimum Base-Metal Thickness: 0.018 inch (0.45 mm).
 - b. Depth: 2-1/2 inches (64 mm).
 - 3. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch (22 mm) deep.
 - a. Minimum Base-Metal Thickness: 0.033 inch (0.84 mm).
 - 4. Resilient Furring Channels: 1/2-inch- (13-mm-) deep members designed to reduce sound transmission.
 - a. Configuration: Asymmetrical.

2.4 AUXILIARY MATERIALS

- A. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- B. Isolation Strip at Exterior Walls: Provide asphalt saturated organic felt.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C 754.
 - 1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

- B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.
- C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- D. Install bracing at terminations in assemblies.
- E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.2 INSTALLING FRAMED ASSEMBLIES

- A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
- B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- C. Install studs so flanges within framing system point in same direction.
- D. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.
 - 1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
 - 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
 - a. Install two studs at each jamb unless otherwise indicated.
 - b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch (13-mm) clearance from jamb stud to allow for installation of control joint in finished assembly.
 - c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
 - 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
 - 4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
 - a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
- E. Direct Furring:
 - 1. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.
- F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

3.3 INSTALLING SUSPENSION SYSTEMS

- A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- C. Suspend hangers from building structure as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.

- a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
4. Do not attach hangers to steel roof deck.
5. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.
- E. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 092216

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Interior gypsum board.
 - 2. Acoustical sound attenuation insulation.

1.2 ACTION SUBMITTALS

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

1.3 QUALITY ASSURANCE

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. American Gypsum.
 - 2. CertainTeed Corp.
 - 3. Georgia-Pacific Gypsum LLC.
 - 4. Lafarge North America Inc.
 - 5. National Gypsum Company.
 - 6. USG Corporation.
 - 7. Substitutions: See Section 012500 - Substitution Procedures.

2.2 INTERIOR GYPSUM BOARD

- A. Gypsum Board, Type X: ASTM C 1396/C 1396M.
 - 1. Thickness: 5/8 inch (15.9 mm).
 - 2. Long Edges: Tapered and featured (rounded or beveled) for prefilling.
- B. Gypsum Ceiling Board: ASTM C 1396/C 1396M.
 - 1. Thickness: 5/8 inch (15.9 mm).
 - 2. Long Edges: Tapered.
- C. Abuse Resistant Gypsum Fiber Board, Type X: ASTM C 1396/C 1396M.
 - 1. Thickness: 5/8 inch (15.9 mm).
 - 2. Long Edges: Tapered.
 - 3. Abrasion: ASTM C1629. Level 1
 - 4. Indentation: ASTM C1629/C1629M. Level 1.
 - 4. Soft-Body Impact: ASTM C1629/C1629M, Level 2.
 - 4. Hard-Body Impact: ASTM C1629/C1629M, Level 1.

2.3 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.
 - 1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized steel sheet.
- B. Aluminum Trim: ASTM B 221 (ASTM B 221M), Alloy 6063-T5.

2.4 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475/C 475M.
- B. Joint Tape:
 - 1. Interior Gypsum Board: Paper.
 - 2. Tile Backing Panels: As recommended by panel manufacturer.
- C. Joint Compound for Interior Gypsum Board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
 - 1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
 - 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.
 - 3. Fill Coat: For second coat, use drying-type, all-purpose compound.
 - 4. Finish Coat: For third coat, use drying-type, all-purpose compound.
 - 5. Skim Coat: For final coat of Level 5 finish, use drying-type, all-purpose compound or high-build interior coating product designed for application by airless sprayer and to be used instead of skim coat to produce Level 5 finish.

2.5 AUXILIARY MATERIALS

- A. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
 - 1. Laminating adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
- C. Sound Attenuation Blankets: Mineral-fiber blanket insulation consisting of fibers manufactured from rock or slag.
 - 1. Unfaced Mineral-Fiber Blanket Insulation: ASTM C 665, Type I (blankets, without membrane facing) with maximum flame-spread and smoke-developed indices of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics. Complying with ASTM E 413 - Rating for Sound Insulation.
 - a. Thickness and Density per ASTM C 167 for a minimum thickness of 2-inches with the density to be 2.5 lbs/cubic foot.
 - b. Acoustical Performance rating per ASTM C 423 with an Absorption Co-efficient at frequencies (NRC). For 2-inches thick the NRC shall be a minimum of 0.95.
 - 2. To be utilized at all interior partitions and columns where sound attenuation (acoustical) insulation is indicated on the Drawings.
- D. Acoustical Joint Sealant: ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings as demonstrated by testing according to ASTM E 90.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Accumetric LLC; BOSS 824 Acoustical Sound Sealant.
 - b. Grabber Construction Products; Acoustical Sealant GSC.
 - c. Pecora Corporation; AC-20 FTR.
 - d. Specified Technologies, Inc.; Smoke N Sound Acoustical Sealant.
 - e. USG Corporation; SHEETROCK Acoustical Sealant.
 - f. Substitutions: See Section 012500 - Product Requirements.
 - 2. Acoustical joint sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 3. To be utilized at all interior partitions and columns indicated to have sound attenuation blankets on the Drawings.
- E. Isolation Strip at Exterior Walls:

1. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No. 15 asphalt felt), nonperforated.
2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8-inch (3.2-mm) thick, in width to suite steel stud size.

2.6 REVEALS

- A. Acceptable manufacturer; subject to compliance with pecified requirements:
 1. Fry Reglet Corporation
- B. Materials and Finish
 1. Anodized finish:
 - a. Architectural 200R1 medium etch (AA-M32c10A21), clear color. Standard finish.
- C. Reveal molding.
 1. Acceptable product: Number DRM.
 2. Characteristics:
 - a. Description: Molding shall create a vertical or horizontal recessed reveal.
 - b. Material: Extruded aluminum.
 - c. Dimensions: As indicated on drawings.
- D. "Z" reveal molding.
 1. Acceptable product: Number DRMZ.
 2. Characteristics:
 - a. Description: Reveal molding shall form a trim reveal around doors or between walls and floors.
 - b. Material: Extruded aluminum.
 - c. Dimensions: As indicated on drawings.

PART 3 - EXECUTION

3.1 APPLYING AND FINISHING PANELS

- A. Comply with ASTM C 840.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Gypsum board at wall bases must be separated from carpet by 1-inch minimum or use of waterproof film to prevent water transfer from floor.
- D. Install sound attenuation blankets before installing gypsum panels, unless blankets are readily installed after panels have been installed on one side.
- E. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- F. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16-inch (1.5 mm) of open space between panels. Do not force into place.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

- H. Install trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
 - 1. Aluminum Trim: Install in locations indicated on Drawings.
 - 2. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.
- I. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- J. Remove and replace panels that are wet, moisture damaged, and mold damaged.

3.2 APPLYING INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
 - 1. Type X: Where required for fire-resistance-rated assembly and at all gypsum board locations, unless noted otherwise on Drawings.
 - 2. Ceiling Type: Provide sag-resistant gypsum board for ceiling application.
- B. Single-Layer Application:
 - 1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing, unless otherwise indicated.
 - 2. On partitions/walls, apply gypsum panels horizontally (perpendicular to framing), unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
 - 3. Fastening Methods: Apply gypsum panels to supports with steel drill screws.
- C. Multilayer Application:
 - 1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches (400 mm) minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
 - 2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
 - 3. On Z-furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
 - 4. Fastening Methods: Fasten base layers and face layers separately to supports with screws.
- D. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written recommendations and temporarily brace or fasten gypsum panels until fastening adhesive has set.

3.3 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.
- C. Interior Trim: Install in the following locations:
 - 1. Cornerbead: Use at outside corners, unless otherwise indicated.
 - 2. LC-Bead: Use at exposed panel edges.

3. L-Bead: L-shaped; exposed long flange receives joint compound.
4. U-Bead: J-shaped; exposed short flange does not receive joint compound, use at exposed panel edges.

3.4 FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints, rounded or beveled edges, and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below:
 1. Level 1: Ceiling plenum areas and concealed areas.
 2. Level 2: Where panels form substrates for ceramic and acoustical tile.
 3. Level 4: At panel surfaces that will be exposed to view.
 - a. Primer and its application to surfaces are specified in other Division 9 Sections.
- E. For Level 4 gypsum board finish, embed tape in joint compound and apply first, fill (second) and finish (third) coat of joint compound over joints, angles, fastener heads, and accessories. Touch up and sand between coats and after last coat as needed to produce a surface free of visual defects and ready for decoration.
- F. For Level 2 gypsum board finish, embed tape in joint compound and apply first coat of joint compound.
- G. For Level 1 gypsum board finish, embed tape in joint compound.
- H. Tile Backing Panels: Finish according to manufacturer's written instructions.

3.5 PROTECTION

- A. Protect adjacent surfaces from drywall compound and promptly remove them from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- C. Remove and replace panels that are wet, moisture damaged, and mold damaged.

END OF SECTION 092900

SECTION 093013 - CERAMIC TILING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Porcelain tile.
 - 2. Tile backing panels.
 - 3. Waterproof & crack isolation membrane
 - 4. Grout materials.
 - 5. Metal edge strips.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples:
 - 1. Each type and composition of tile and for each color and finish required.
 - 2. Metal edge strips in 6" length

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Tile and Trim Units: Furnish quantity of full-size units equal to 5 percent of amount installed for each type, composition, color, pattern, and size indicated.
 - 2. Locate extra materials where indicated by the Owner.
 - 3. Grout: Furnish quantity of grout equal to 2 percent of amount installed for each type, composition, and color indicated.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. An experienced installer with a minimum of ten (10) years of experience installing similar types of ceramic tile.
 - 2. Installer uses best practices as outlined in the TCNA (Tile Council of North America) handbook.
- B. Pre-installation Meeting: Contractor to schedule a pre-installation meeting with the Architect and Construction Manager to verify selections made under sample submittals and to set quality standards for materials and execution.
 - 1. Contractor to provide a mockup as part of the Pre-installation meeting. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

PART 2 - PRODUCTS

2.1 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide Standard-grade tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.

2.2 TILE PRODUCTS

- A. Ceramic Tile Types: Ceramic tile for walls. Refer to "Finish Material Schedule" on drawing A3.00 for product information.
 - 1. Grout Color: As selected by Architect from manufacturer's full range.

2.3 TILE BACKING PANELS

- A. Cementitious Backer Units: ANSI A118.9 or ASTM C 1325, Type A.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. James Hardie; HARDIEBACKER Cement board
 - b. Substitutions: See Section 012500 - Substitution Procedures.
 - 2. Thickness: 1/2 inch (12.7 mm)
 - 3. Application areas: Backing panels shall be installed in the locations specified and as indicated in the drawings.
 - a. Walls with the following conditions:
 - 1) 2 or more dissimilar surface materials
 - 2) New construction with uneven surfaces that prevent tile installation to be level and plumb. Refer to TCNA guidelines "Subsurface Tolerances for Thin-Bed Method".

2.4 WATERPROOF AND CRACK ISOLATION MEMBRANE

- A. General: Manufacturer's standard product that complies with ANSI A118.10 and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.
- B. Fluid-Applied Membrane: Liquid-latex rubber or elastomeric polymer.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide LATICRETE International, Inc.; Laticrete Hydro Ban.

2.5 SETTING MATERIALS

- A. Modified Dry-Set Mortar (Thinset): ANSI A118.4.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide LATICRETE International, Inc; Laticrete Tri-lite; or a comparable product by one of the following:
 - a. ARDEX Americas.
 - b. Bonsal American, an Oldcastle company.

- c. Bostik, Inc.
- d. H.B. Fuller Construction Products Inc. / TEC.
- e. MAPEI Corporation.
- f. Substitutions: See Section 012500 - Substitution Procedures.
2. Provide prepackaged, dry-mortar mix to which only water must be added at Project site.
3. For wall applications, provide non-sagging mortar.

2.6 GROUT MATERIALS

- A. Sand-Portland Cement Grout: ANSI A108.10, consisting of white or gray cement and white or colored aggregate as required to produce color indicated.
- B. High-Performance Tile Grout: ANSI A118.7.
 1. Basis-of-Design Product: Subject to compliance with requirements, provide TEC; InColor or a comparable product by one of the following:
 - a. Laticrete International
 - b. ARDEX Americas.
 - c. Bonsal American, an Oldcastle company.
 - d. Bostik, Inc.
 - e. MAPEI Corporation.
 - f. Substitutions: See Section 012500 - Substitution Procedures.
 2. Polymer Type: Dry, re-dispersible form, prepackaged with other dry ingredients.
 3. Polymer Type: Liquid-latex form for addition to prepackaged dry-grout mix.
- C. Water-Cleanable Epoxy Grout: ANSI A118.3, with a VOC content of 65 g/L or less.
 1. Basis-of-Design Product: Subject to compliance with requirements, provide TEC EFX Epoxy or a comparable product by one of the following:
 - a. Laticrete
 - b. ARDEX Americas.
 - c. Bonsal American, an Oldcastle company.
 - d. Bostik, Inc.
 - e. MAPEI Corporation.
 - f. Substitutions: See Section 012500 - Substitution Procedures.

2.7 ELASTOMERIC SEALANTS

- A. Refer to Section 079200 "Joint Sealants" for sealant requirements.

2.8 MISCELLANEOUS MATERIALS

- A. Trowel-able Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.
- B. Metal Edge Strips: Angle or L-shape, height to match tile and setting-bed thickness, stainless steel, ASTM A 666, 300 Series.
 1. Manufacturer: Provide Schluter Systems or Architect-approved equal. Substitutions: See Section 012500 - Substitution Procedures.
 2. Schedule of Profiles: As indicated on finish legend in the drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
 - 1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Fill cracks, holes, and depressions in concrete substrates for tile walls installed with thinset mortar with trowel-able leveling and patching compound specifically recommended by tile-setting material manufacturer.
- B. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot (1:50) toward drains.
- C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 CERAMIC TILE INSTALLATION

- A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.
 - 1. For the following installations, follow procedures in the ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:
 - a. Ceramic tile walls
- B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
- D. Jointing Pattern: Lay tile in patterns indicated on drawings. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
- E. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
 - 1. Ceramic Wall Tile: 3/16 inch.
- F. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, as recommended by TCNA. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.

1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.
 2. **Review locations of expansion joints with Architect prior to installation.**
 3. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants".
- G. Install tile backing panels and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated. Use modified dry-set mortar for bonding material unless otherwise directed in manufacturer's written instructions.
- H. Grout Sealer: Apply grout sealer to cementitious grout joints in tile floors according to grout-sealer manufacturer's written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

3.4 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE

- A. Interior Floor Installations, Concrete subfloor:
1. Ceramic Tile Installation: TCNA F125-Full; thinset mortar on crack isolation membrane
 - a. Ceramic Tile
 - b. Thinset Mortar: Modified dry-set mortar.
 - c. Grout: Water-cleanable epoxy grout.
- B. Interior Wall Installations, Backer Board over Metal Studs:
1. Ceramic Tile Installation: TCNA W244C; thinset mortar.
 - a. Ceramic Tile
 - b. Thinset Mortar: Modified dry-set mortar.
 - c. Grout: High-performance sanded grout
 - d. Grout: Water-cleanable epoxy grout in toilet rooms & wet areas

END OF SECTION 093013

SECTION 09 50 00 - ACOUSTICAL METAL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Section Includes

Drawings and general conditions of Contract, including General and Supplementary Conditions and Divisions-1 Specification sections apply to work of this section

1.2 SUMMARY

A. Section Includes

1. Acoustical metal ceiling panels
2. Exposed grid suspension system
3. Wire hangers, fasteners, main runners, cross tees, and wall angle moldings
4. Perimeter Trim

B. Alternates

1. Prior Approval: Unless otherwise provided for in the Contract documents, proposed product substitutions may be submitted no later than TEN (10) working days prior to the date established for receipt of bids. Acceptability of a proposed substitution is contingent upon the Architect's review of the proposal for acceptability and approved products will be set forth by the Addenda. If included in a Bid are substitute products that have not been approved by Addenda, the specified products shall be provided without additional compensation.

2. Submittals that do not provide adequate data for the product evaluation will not be considered. The proposed substitution must meet all requirements of this section, including but not necessarily limited to, the following: Single source materials suppliers (if specified in Section 1.5); Underwriters' Laboratories' Classified Acoustical performance; Panel design, size, composition, color, and finish; Suspension system component profiles and sizes; Compliance with the referenced standards.

1.3 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM A 1008 Standard Specification for Steel, Sheet, Cold Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
2. ASTM A 641 Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
3. ASTM A 653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
4. ASTM C 423 Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method

5. ASTM C 635 Standard Specification for Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings

6. ASTM C 636 Recommended Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels

7. ASTM D 3273 Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber

8. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials

9. ASTM E 580 Installation of Metal Suspension Systems in Areas Requiring Moderate Seismic Restraint

10. ASTM E 1111 Standard Test Method for Measuring the Interzone Attenuation of Ceilings Systems

11. ASTM E 1414 Standard Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum

12. ASTM E 1264 Classification for Acoustical Ceiling Products

B. International Building Code

C. ASHRAE Standard 62.1-2004 Ventilation for Acceptable Indoor Air Quality

D. NFPA 70 National Electrical Code

E. ASCE 7 American Society of Civil Engineers, Minimum Design Loads for Buildings and Other Structures

F. International Code Council-Evaluation Services - AC 156 Acceptance Criteria for Seismic Qualification Testing of Non-structural Components

G. International Code Council-Evaluation Services Report - Seismic Engineer Report

H. International Association of Plumbing and Mechanical Officials - Seismic Engineer Report

1.4 SYSTEM DESCRIPTION

Discontinuous/Open Plenum

1.5 SUBMITTALS

A. Product Data: Submit manufacturer's technical data for each type of acoustical ceiling unit and suspension system required.

B. Samples: Minimum 6 inch x 6 inch samples of specified acoustical panel; 8 inch long samples of exposed wall molding and suspension system, including main runner and 4 foot cross tees.

C. Shop Drawings: Layout and details of acoustical ceilings show locations of items that are to be coordinated with, or supported by the ceilings.

D. Certifications: Manufacturer's certifications that products comply with specified requirements, including laboratory reports showing compliance with specified tests and standards. For acoustical performance, each carton of material must carry an approved independent laboratory classification of NRC, CAC, and AC.

E. If the material supplied by the acoustical subcontractor does not have an Underwriter's Laboratory classification of acoustical performance on every carton, subcontractor shall be required to send material from every production run appearing on the job to an independent or NVLAP approved laboratory for testing, at the architect's or owner's discretion. All products not conforming to manufacturer's current published values must be removed, disposed of and replaced with complying product at the expense of the Contractor performing the work.

1.6 QUALITY ASSURANCE

A. Single-Source Responsibility: Provide acoustical panel units and grid components by a single manufacturer.

B. Fire Performance Characteristics: Identify acoustical ceiling components with appropriate markings of applicable testing and inspecting organization.

a. Surface Burning Characteristics: As follows, tested per ASTM E 84 and complying with ASTM E 1264 Classification.

C. Acoustic Panels: As with other architectural features located at the ceiling, may obstruct or skew the planned fire sprinkler water distribution pattern through possibly delay or accelerate the activation of the sprinkler or fire detection systems by channeling heat from a fire either toward or away from the device. Designers and installers are advised to consult a fire protection engineer, NFPA 13, or their local codes for guidance where automatic fire detection and suppression systems are present.

D. Coordination of Work: Coordinate acoustical ceiling work with installers of related work including, but not limited to building insulation, gypsum board, light fixtures, mechanical systems, electrical systems, and sprinklers.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver acoustical ceiling units to project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical ceiling units, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical ceiling units carefully to avoid chipping edges or damaged units in any way.

1.8 PROJECT CONDITIONS

A. Space Enclosure:

Standard Ceilings: Do not install interior ceilings until space is enclosed and weatherproof; wet work in place is completed and nominally dry; work above ceilings is complete; and ambient conditions of temperature and humidity are continuously maintained at values near those intended for final occupancy. Building areas to receive ceilings shall be free of construction dust and debris.

HumiGuard Plus Ceilings: Building areas to receive ceilings shall be free of construction dust and debris. Products with HumiGuard Plus performance and hot dipped galvanized steel, aluminum or stainless steel suspension systems can be installed up to 120°F (49°C) and in spaces before the building is enclosed, where HVAC systems are cycled or not operating. Cannot be used in exterior applications where standing water is present or where moisture will come in direct contact with the ceiling.

HumiGuard Max Ceilings: Building areas to receive ceilings shall be free of construction dust and debris. Ceilings with HumiGuard Max performance can be installed in conditions up to 120°F (49°C) and maximum humidity exposure including outdoor applications, and other standing water applications, so long as they are installed with either SS Prelude Plus, AL Prelude Plus, or Prelude Plus Fire Guard XL suspension systems. Products with HumiGuard Max performance can be installed in exterior applications, where standing water is present, or where moisture will come in direct contact with the ceiling. Only Ceramaguard with AL Prelude Plus suspension system can be installed over swimming pools.

1.9 WARRANTY

A. Acoustical Panel: Submit a written warranty executed by the manufacturer, agreeing to repair or replace panels that fail within the warranty period. Failures include, but are not limited to the following:

1. Acoustical Panels: Sagging and warping
2. Grid System: Rusting and manufacturer's defects

B. Warranty Period:

1. Acoustical Metal panels: One (1) year from date of substantial completion
2. Grid: Ten (10) years from date of substantial completion

C. The Warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

1.10 MAINTENANCE

A. Extra Materials: Deliver extra materials to Owner. Furnish extra materials described below that match products installed. Packaged with protective covering for storage and identified with appropriate labels.

1. Acoustical Metal Ceiling Units: Furnish quality of full-size units equal to 5.0 percent of amount installed.

2. Exposed Suspension System Components: Furnish quantity of each exposed suspension component equal to 2.0 percent of amount installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:

1. Basis-of-Design products: Subject to compliance with requirements, provide products specified.

a. Equal products as manufactured by Armstrong World Industries, Inc., Celotex Corporation or CertainTeed Corp. are also acceptable

A. Metal Ceiling Panels:

1. Basis-of-Design: Moz Designs

B. Suspension Systems:

1. Basis-of-Design: Moz Designs

C. Aluminum Custom Trims:

1. Basis-of-Design: Moz Designs

2.2.1 ACOUSTICAL CEILING UNITS

A. Products: **AMC-1**

1. Basis-of-Design: Moz Design

a. Surface Texture: Perforated 1/8" diameter

b. Composition: Metal

c. Color: As indicated in drawings

d. Size: Custom

e. Edge Profile: Custom; Key Slot

f. Flame Spread: ASTM E 1264; Class A.

h. Dimensional Stability: Standard

2. Metal Panel Accessories:

1. Basis of Design: Armstrong Worldwide Industries, Inc.
 - a. 5823 - 1" Fiberglass Infill Panel - BLACK MATTE

2.3.1 METAL SUSPENSION SYSTEMS

A. Components:

Key Slot ceiling system

- a. Basis-of-Design: Moz Design
- b. Structural Classification: ASTM C 635 Heavy Duty duty
- c. Color: Concealed

B. Attachment Devices:

Size for five times design load indicated in ASTM C 635, Table 1, Direct Hung unless otherwise indicated.

C. Wire for Hangers and Ties:

ASTM A 641, Class 1 zinc coating, soft annealed, with a yield stress load of at least three design load, but not less than 12 gauge.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Do not proceed with installation until all wet work such as concrete, terrazzo, plastering and painting has been completed and thoroughly dried out, unless expressly permitted by manufacturer's printed recommendations. (Exception: HumiGuard Max Ceilings)

3.2 PREPARATION

A. Measure each ceiling area and establish layout of acoustical units to balance border widths at opposite edges of each ceiling. Avoid use of less than half width units at borders, and comply with reflected ceiling plans. Coordinate panel layout with mechanical and electrical fixtures.

B. Coordination: Furnish layouts for preset inserts, clips, and other ceiling anchors whose installation is specified in other sections.

1. Furnish concrete inserts and similar devices to other trades for installation well in advance of time needed for coordination of other work.

3.3 INSTALLATION

A. Follow manufacturer installation instructions

B. Install suspension system and panels in accordance with the manufacturer's instructions, and in compliance with ASTM C 636 and with the authorities having jurisdiction.

C. Install wall moldings at intersection of suspended ceiling and vertical surfaces. Miter corners where wall moldings intersect or install corner caps.

D. For reveal edge panels: Cut and reveal or rabbet edges of ceiling panels at border areas and vertical surfaces.

E. Install acoustical panels in coordination with suspended system, with edges resting on flanges of main runner and cross tees. Cut and fit panels neatly against abutting surfaces. Support edges by wall moldings.

F. Install acoustical panels in coordination with suspended system, with edges resting on flanges of main runner and cross tees. Cut and fit panels neatly against abutting surfaces. Support edges by wall moldings.

3.4 ADJUSTING AND CLEANING

A. Replace damaged and broken panels.

B. Clean exposed surfaces of ceilings panels, including trim, edge moldings, and suspension members. Comply with manufacturer's instructions for cleaning and touch up of minor finish damage. Remove and replace work that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION - 095000

SECTION 095113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes acoustical panels and exposed suspension systems for ceilings.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Maintenance data.

1.3 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of acoustical ceiling panel and supporting suspension system through one source from a single manufacturer.
- B. Fire-Test-Response Characteristics:
 - 1. Surface-Burning Characteristics: Acoustical panels complying with ASTM E 1264 for Class A materials, when tested per ASTM E 84.
 - a. Smoke-Developed Index: 450 or less.
- C. Preinstallation Conference: Conduct conference at Project site.

1.4 WARRANTY

- A. Manufacturer's standard form where manufacturer agrees to replace defective products within the specified period:
 - 1. Warranty Period: 30 years against visible sag, mold, mildew, and bacteria.

1.5 PROJECT CONDITIONS

- A. Environmental Limitation: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

1.6 COORDINATION

- A. Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment and partition assemblies.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Acoustical Ceiling Panels: Full-size panels equal to 5.0 percent of quantity installed.
 - 2. Suspension System Components: Quantity of each exposed component equal to 2.0 percent of quantity installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:
1. Basis-of-Design products: Armstrong World Industries, Inc.,
Subject to compliance with requirements, provide products specified.
 - a. Celotex Corporation
 - b. CertainTeed Corp.
 - c. Substitutions: See Section 012500 - Substitution Procedures.

2.2 GENERAL

- A. Acoustical Panel Standard: Comply with ASTM E 1264.
- B. Metal Suspension System Standard: Comply with ASTM C 635.
- C. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
- D. Wire Hangers, Braces, and Ties: Zinc-coated carbon-steel wire; ASTM A 641/A 641M Class 1 zinc coating, soft temper.
1. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch- (2.69-mm-) diameter wire.
- E. Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that fit acoustical panel edge details and suspension systems indicated; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners. Where bullnose corners occur, provide preformed corners to match edge moldings.
- F. Antimicrobial Fungicide Treatment: Provide acoustical panels with face and back surfaces coated with antimicrobial treatment consisting of manufacturer's standard formulation with fungicide added to inhibit growth of mold and mildew and showing no mold or mildew growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21.

2.3 ACOUSTICAL PANELS,

- A. Products: **AP-1:**
1. Basis-of-Design: Armstrong, Inc.; Product: Calla High-NRC.
 2. Color: White.
 3. LR: Not less than 0.84.
 4. NRC: Not less than 0.70.
 5. CAC: Not less than 35.
 6. Edge Detail: Square.
 7. Thickness: 3/4 inch.
 8. Size: 24 by 24.
- B. Products: **AP-2:**
1. Basis-of-Design: Armstrong, Inc.; Product: Clean Room Lay In Gypsum Ceiling panels
 2. Color: White
 3. LR: Not less than 0.75.
 4. Edge Detail: Square.
 5. Thickness: 1 inch.
 6. Size: 24 by 24.

- C. Products: **AG-1:**
 - 1. Basis-of-Design: Armstrong, Inc.; Product: Acoustibuilt
 - 2. Color: White
 - 3. LR: Not less than 0.75.
 - 4. Edge Detail: Square.
 - 5. Thickness: 1 inch.
 - 6. Accessories: 5823 - 1" Fiberglass Infill Panel - BLACK MATTE

2.4 METAL SUSPENSION SYSTEM

- A. Wide-Face Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, pre-painted, electrolytically zinc coated, and hot-dip galvanized according to ASTM A 653/A 653M, with prefinished 15/16-inch-wide metal caps on flanges.
 - 1. Structural Classification: Intermediate-duty system.
 - 2. End Condition of Cross Runners: Butt-edge type.
 - 3. Cap Material: Steel cold-rolled sheet.
 - 4. Cap Finish: Painted white.
- B. Basis-of-Design Manufacturer: USG Interiors, Inc.
 - 1. Equal products as manufactured by Armstrong World Industries, Inc., CertainTeed Corporation, or Celotex Corporation are also acceptable.
 - 2. Substitutions: See Section 012500 - Substitution Procedures.
- C. Schedule of Suspension System Types:
 - 1. Donn Brand Identitee DXI.
 - 2. Substitutions: See Section 012500 - Substitution Procedures.
- D. Provide manufacturer's standard wall molding for all ceiling types.
- E. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with ASTM C 636 per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
- B. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.
- C. Suspend ceiling hangers from building's structural members, plumb and free from contact with insulation or other objects within ceiling plenum. Splay hangers only where required and, if permitted with fire-resistance-rated ceilings, to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers, use trapezes or equivalent devices. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
 - 1. Do not attach hangers to steel deck tabs or to steel roof deck. Attach hangers to structural members.
 - 2. Space hangers not more than 48-inches (1200 mm) o.c. along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than 8-inches (200 mm) from ends of each member.
 - 3. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.

- D. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs.
- E. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels. Screw attach moldings to substrate at intervals not more than 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3.2 mm in 3.6 m). Miter corners accurately and connect securely.
- F. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- G. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.

3.2 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings and suspension system members. Comply with manufacturer's instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095113

SECTION 09 54 23 - LINEAR PVC CEILINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Endure Ceiling Panels
- B. Suspension Systems

1.2 RELATED SECTIONS

- A. Section 07 90 00 - Joint Protection.
- B. Section 09 51 13 - Acoustic Panel Ceilings.
- C. Section 28 31 00 - Fire Detection and Alarm.
- D. Section 21 00 00 - Fire Suppression.
- E. Section 26 51 00 - Interior Lighting.

1.3 REFERENCES

- A. ASTM E 84 - Title; 2001.
- B. U.S. Green Building Council, LEED Building Design and Construction (BD+C)Version 4.0 Rating System. (LEED v4.0)

1.4 DESIGN / PERFORMANCE REQUIREMENTS

- A. Suspension System: Rigidly secure acoustic ceiling system including integral mechanical and electrical components with maximum deflection of 1:360.
- B. Linear ceilings will undergo changes with variations in the environment. Therefore, all dimensional tolerances are plus or minus 1/8 inch (3 mm).
- C. Seismic: Suspended ceilings meet seismic code compliance via direct screw attachment to heavy duty grid. Local code requirements should be consulted in order to determine additional requirements.
- D. Fire Performance Characteristics: Suspended ceilings shall conform to Class 1, or A flame spread rating, tested according to ASTM E 84; Flame Spread: 25 or less. Smoke Developed: 450 or less.

1.5 SUBMITTALS

- A. Submit under provisions of Section 01 30 00 - Administrative Requirements.
- 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 layout of linear ceiling and hat channel coordinated with other trades that will penetrate the linear ceiling or interfere with the installation and recessed or surface mounted devices located within the ceiling panels. Indicate method of suspension where interference exists.
- D. LEED Submittals: Provide documentation of how the requirements of Credit will be met:
 - 1. LEED v4.0: Suspended ceilings may contribute as required to the following LEED v4 credits: MR BPD&O - Sourcing of Raw Materials, MR BPD&O - Material Ingredients, EQ Low-Emitting Materials.
- E. Selection Samples: For each finish product specified, two complete sets of color brochures representing the manufacturer's full range of available colors and patterns.
- F. Verification Samples: For each finish product specified, two samples, minimum size 12 inches (305 mm) square, representing actual product, color, and patterns.
- G. Manufacturer's Certificates: Certify products meet or exceed specified requirements.
- H. Closeout Submittals: Provide manufacturer's maintenance instructions that include recommendations for periodic checking and adjustment and periodic cleaning and maintenance of all components.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Installer Qualifications: Minimum 2 years documented experience installing projects of similar size and complexity.
- C. Provide seismic design of suspended linear ceiling under direct supervision of Professional Engineer experienced in design of this Work and licensed at Project location.
- D. 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.
 - 4. Accepted mock-ups shall be comparison standard for remaining Work
- E. Pre-Installation Conference: Convene minimum two weeks prior to starting work of this section. Agenda shall include project conditions, coordination with work of other trades, and layout of items that penetrate ceilings.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver material in the manufacturer's original, unopened, undamaged containers with identification labels intact.
- B. Store products off the floor in manufacturer's unopened packaging protected

from exposure to harmful environmental conditions and at temperature and humidity conditions as recommended by the manufacturer.

- C. A minimum of 72 hours prior to ceiling installation, suspended linear ceilings shall be stored in the room in which they will be installed. Temperature and humidity of the room during this period shall closely approximate those conditions that will exist when the building is occupied.
- D. Handle materials to avoid damage.

1.8 SEQUENCING

- A. Ensure that locating templates and other information required for installation of products of this section are furnished to affected trades in time to prevent interruption of construction progress.
- B. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

1.9 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.
- B. Plenums have proper ventilation, especially in high moisture areas with no excessive buildup of heat in the ceiling areas.
- C. Space shall be fully enclosed with all exterior windows and doors in place, glazed, and weather-stripped. Roof is to be watertight, and all wet trades' work is to be completed, and thoroughly dry.
- D. Mechanical, electrical, and other utility services above the ceiling plane shall be completed. No materials should rest against, or wrap around, the ceiling suspension components or connecting hangers.
- E. Install only when the temperature and humidity closely approximate the interior conditions that will exist when the building is occupied. Heating and cooling systems shall be operating before, during, and after installation, with the humidity of the interior spaces maintained between 25 and 55 percent, and a temperature between 60 to 90 degrees F.

1.10 COORDINATION

- A. Coordinate layout and installation of the linear ceiling systems with other work penetrating the ceiling including light fixtures, HVAC equipment, and fire suppression system components.

1.11 EXTRA MATERIALS

- A. See Section 01 60 00 - Substitution Procedures.
- B. Deliver materials for Owner's use in maintenance.
 - 1. Provide ___ percent of each type actually installed for use by owner in building maintenance and repair.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturer: Rulon International, which is located at: 2000 Ring Way Rd.; St Augustine, FL 32092; Toll Free Tel: 800-227-8566; Tel: 904-584-1400; Fax: 904-584-1499; Email: [request info \(info@rulonco.com\)](mailto:info@rulonco.com); Web:rulonco.com
- A. Substitutions: See Section 01 25 00 - Substitution Procedures.

2.2 MATERIALS - GENERAL

- A. Linear ceilings will undergo changes with variations in the environment. Therefore, all dimensional tolerances are plus or minus 1/8 inch (3 mm).

2.3 ENDURE CEILING PANELS

- A. Endure suspended linear systems are fabricated with strips that are nearly inert to harsh, moist weather conditions. Strips are completely recyclable.
 - 1. 800 Series Engineered Polymer Strips:
 - a. Ceiling pans are provided with spacers between the edges of each strip, with the flat face visible.
 - b. Ceiling pans are 3-1/4 inches (83 mm) wide, and placed into a design module of 4 inches (102 mm) with square sides.
 - 2. 900 Series Engineered Polymer Strips:
 - a. Ceiling pans are provided with integral spacers between the edges of each strip, with the flat face visible.
 - b. Ceiling pans are 3-1/4 inches (83 mm) wide with an integral 3/4 inch (19 mm) spacer and placed into a design module of 4 inches (102 mm) with square sides.
 - 3. Trim and Border Treatment: Provide end caps or junction trims as indicated.
 - 4. Color:
 - a. As selected by the Architect from the manufacturer standard selections.

2.4 ACCESSORIES

- A. Acoustic Infil:
 - 1. Basis of Design:
 - a. Armstrong Industries, Inc.
 - 1) 5823 - 1" Fiberglass Infill Panel - BLACK MATTE

2.5 SUSPENSION SYSTEMS

- A. Suspension Rail: Standard suspension carrier shall be of Rulon manufacture, and consist of commercial grade steel with surface prepared, and painted. In swimming pool and other corrosive environments, use the Rulon suspension carrier coated with black protective coating system.

2.6 FABRICATION

- A. Edges, borders, and perimeter trims shall be indicated on the Drawings in accordance with the manufacturer's standard design details. All suspended linear ceiling products specified shall be supplied by the wood slat ceiling manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. Verify that suspension rail specified in Section 09 22 26 - Suspension Systems are in place, suspended and leveled in a direction perpendicular to the strip direction of the linear panels.
- C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Work shall not begin until the space is fully enclosed and glazed and all wet work is completed and dried out to the satisfaction manufacturer.
- C. Temperature shall be at least 65 degrees Fahrenheit during the installation and thereafter.
- D. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions and in proper relationship with adjacent construction, including the following:
 - 1. Comply with ASTM C 636 and seismic design requirements indicated.
 - 2. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 - 3. Additional Hanger Wires: Wrapped tightly 3 full turns to structure and component at locations where imposed loads could cause deflection exceeding 1/360 span or tolerances specified below.
- B. Perimeters: Use a laser leveling device to lay out and install the perimeter trim as specified.
- C. Suspension System: Suspension rail shall be placed perpendicular to the desired linear strip direction and positioned on 3' (915mm) or 2' (610mm) centers - as specified by the manufacturer. Carriers shall be suspended from specified hangers - starting 6" (152mm) from one wall, then on specified centers, with the last carrier positioned within 6" (152mm) of the other wall. Specified hangers shall be attached directly to structure, or to inserts, screw eyes, or other devices that are secure, and that will not deteriorate or fail with age or elevated temperatures.
- D. Linear Strips: Linear strips shall be fully attached to the carrier by snapping one side of the strip into position first, followed by the second side. When properly installed, the strips shall be firmly secured, and fully level. When spacers and acoustical blankets are specified, they shall be fitted as the installation of strips progresses. End cuts are butted tight together by snapping a connector behind the strips to create a secure, aligned joint.

- E. Make final adjustments to level or contours as required.

3.4 FIELD QUALITY CONTROL

- A. Technical Service: Manufacturer shall provide a local Technical Service Representative for on-site training and assistance during the installation process.
- B. Environmental Monitoring: Manufacturer shall provide a temperature and humidity sensor to actively monitor the room in which the wood slats shall be installed for a minimum of one week before and up to two weeks after installation has been completed including all of the weeks in between.
- C. Upon completion of ceiling installation, the owner's representative shall inspect all finished surfaces to ensure that the work has been completed in a manner satisfactory to the owner. Any deficiencies in the install of the ceiling shall be corrected prior to substantial completion.

3.5 ADJUSTMENTS AND CLEANING

- A. Clean exposed surfaces of ceiling panel in accordance with manufacturer's instructions.
- B. Remove and replace panels and tiles, which cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

3.6 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

3.7 SCHEDULES

- A. 800 Series Engineered Polymer Strips: LC-1
 - 1. Color:
 - a. As indicated in Drawings
 - 2. Accessories:
 - a. Acoustic Infill
 - b. Felt Strip
 - c. Access door section as indicated in Drawings
 - 3. System Type
 - a. Open Joint
- B. 900 Series Engineered Polymer Strips: LC-2
 - 1. Color:
 - a. As Indicated on drawings
 - 2. System Type:
 - a. ¾" integral spacer

END OF SECTION 095426

SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Resilient base.
 - 2. Resilient Stair accessories.
 - 3. Resilient molding accessories.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified, not less than 12 inches (300 mm) long.

PART 2 - PRODUCTS

2.1 RESILIENT WALL BASE: **RWB-1**

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Roppe Corporation
 - 2. Substitutions: See Section 012500 - Substitution Procedures.
- B. Product Standard: ASTM F 1861, Type TP (rubber, thermoplastic).
 - 1. Group: I Solid
 - 2. Profile: Standard straight base
- C. Height: 4 inches.
- D. Minimum Thickness: 0.125 inch (3.2 mm).
- E. Lengths: Coils in manufacturer's standard length.
- F. Outside Corners: Job formed.
- G. Inside Corners: Job formed.
- H. Colors: refer to "Finish Material Schedule" on drawing A3.00.

2.2 RESILIENT WALL BASE: **RWB-2**

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Roppe Corporation
 - 2. Substitutions: See Section 012500 - Substitution Procedures.
- B. Product Standard: ASTM F 1861, Type TP (rubber, thermoplastic).
 - 1. Group: I Solid
 - 2. Profile: Standard Cove Straight base
- C. Height: 6 inches.
- D. Minimum Thickness: 0.125 inch (3.2 mm).
- E. Lengths: Coils in manufacturer's standard length.
- F. Outside Corners: Job formed.
- G. Inside Corners: Job formed.
- H. Colors: refer to "Finish Material Schedule" on drawing A3.00.

2.3 RESILIENT MOLDING ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Roppe Corporation
 2. VPI, LLC: Floor Products Division
 3. Armstrong World Industries, Inc.
 4. Johnsonite, Inc.
 5. Burke Industries, Inc.
 6. Flexco, Inc.
 7. Mondo Rubber International, Inc.
 8. Nora Rubber Flooring
 9. Mannington Commercial
 10. Tarkett USA, Inc.
 11. Substitutions: See Section 012500 - Substitution Procedures.
- B. Description: Rubber carpet edge for glue-down applications, reducer strip for resilient flooring and transition strips.
- C. Profile and Dimensions: As required per condition. Profile must comply with ADA requirements.
- D. Locations: Provide rubber moldings at all areas where dissimilar flooring materials meet.

2.4 STAIR TREADS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. Roppe Corporation
 2. Substitutions: See Section 012500 - Substitution Procedures.
- B. Product Standard: ASTM F 2169
1. Type: TP (rubber, thermoplastic).
 2. Class: 2 (pattern; embossed, grooved, or ribbed).
 3. Group: 2 (with contrasting color for the visually impaired).
 4. Nosing Style: Square, adjustable to cover angles between 60 and 90 degrees.
 5. Nosing Height: 1-1/2 inches (38 mm).
 6. Thickness: 1/4 inch (6 mm) and tapered to back edge.
 7. Size: Lengths and depths to fit each stair tread in one piece.
 8. Integral Risers: Smooth, flat; in height that fully covers substrate.
- C. Colors and Patterns: As indicated in "Finish Material Legend".

2.5 INSTALLATION MATERIALS

- A. Trowel-able Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.
1. Adhesives shall have a VOC content of 50 g/L or less except that adhesive for rubber stair treads shall have a VOC content of 60 g/L or less.
- C. Stair-Tread Nose Filler: Two-part epoxy compound recommended by resilient stair-tread manufacturer to fill nosing substrates that do not conform to tread contours.
- D. Floor Polish: Provide protective, liquid floor-polish products recommended by resilient stair-tread manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates for Resilient Stair Accessories: Prepare horizontal surfaces according to ASTM F 710.
 - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
 - 3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
 - 4. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. (18.6 sq. m), and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
 - a. Anhydrous Calcium Chloride Test: ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
 - b. Relative Humidity Test: Using in-situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
- C. Fill cracks, holes, and depressions in substrates with trowel-able leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install resilient products until they are the same temperature as the space where they are to be installed.
- E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.2 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, and areas where base is required as shown on the drawings.
- C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Job-Formed Corners:
 - 1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
 - a. Form without producing discoloration (whitening) at bends.
 - 2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
 - a. Miter corners to minimize open joints.

3.3 RESILIENT ACCESSORY INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient accessories.
- B. Resilient Stair Accessories:
 - 1. Use stair-tread-nose filler to fill nosing substrates that do not conform to tread contours.
 - 2. Tightly adhere to substrates throughout length of each piece.
 - 3. For treads installed as separate, equal-length units, install to produce a flush joint between units.
- C. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.
- B. Floor Polish: Remove soil, adhesive, and blemishes from resilient stair treads before applying liquid floor polish.
 - 1. Apply two coats.
- C. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION 096513

SECTION 096723 - RESINOUS FLOORING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes resinous flooring systems.

1.2 PREINSTALLATION MEETINGS

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

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each type of exposed finish required.

1.4 INFORMATIONAL SUBMITTALS

- A. Material certificates.
- B. Material test reports.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring application.
- B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.
- C. Close spaces to traffic during resinous flooring application and for 24 hours after application unless manufacturer recommends a longer period.

1.8 MOCK-UP

- A. Construct one 100 sq.ft. (10 sq.m.) mock-up of each type and color of resinous flooring in location acceptable to Architect/Engineer to demonstrate quality of finished system, complying with manufacturer's instructions.
- B. Arrange for Architect/Engineer's review and acceptance, obtain written acceptance before proceeding with Work.

- C. Upon acceptance, mock-up shall serve as a minimum standard of quality for the balance of the work of this Section. Mock-up shall be left in place for the duration of the work.
- D. Pre-application Meeting: Convene a pre-application meeting two (2) weeks before start of application of floor coating. Require attendance of parties directly affecting work of this section, including Contractor, Architect, applicator, and manufacturer's representative. Review surface preparation, priming, application, curing, protection, and coordination with other work.
- E.

PART 2 - PRODUCTS

2.2 PERORMANCE REQUIREMENTS

- A. Flammability: Self-extinguishing according to ASTM D 635.

2.3 RESINOUS FLOORING

A. RF-1:

1. MANUFACTURER

- a. Manufacturer shall be certified under ISO 9001: 2008 All liquid materials, including primers, resins, curing agents, finish coats, and sealants are manufactured and tested under an ISO 9001:2008 registered quality system.
- b. Approved Manufacturer shall be Sika Corporation, Industrial Flooring, 201 Polito Avenue, Lyndhurst, NJ 07071, Phone 201.933.8800, Fax 201.933.6225, www.sikafloorusa.com

2. SYSTEM

- a. Resinous flooring system: Sika ComfortFloor Pro PS - 65 is an ergonomic, sound dampening, low emission floor which is UV stable, aesthetically pleasing, easy to care for and to maintain while contributing to project LEED certification. Typically applied between 240 to 320 mils thick. System to consist of the following components:
- b. Adhesive: Sikafloor Comfort Adhesive applied with a 3/8" notched trowel.
- c. Shockpad: Sika Comfort Regupol 6015H.
- d. Pore Sealer: Sikafloor Comfort Porefiller applied at 16 mils.
- e. Body Coat: Sikafloor 330 applied at 80 mils.
- f. Top Coat / Color Sealer: Sikafloor 305W applied at 8 mils. (two coats).

3. MATERIALS

- a. Adhesive: Sikafloor Comfort Adhesive is a two component solvent free polyurethane adhesive applied with a 3/8" notched trowel with the following properties:
 - 1) Density Mixed Resin: 12.42 lbs. / gal. All Density values at 73.4°F (+23°C).
 - 2) VOC Content (ASTM D2369): 0 g/L
 - 3) Tensile Strength (ASTM D2370): Resin: 1305 psi. (~ 9.0 N/mm²) (14 days / +23°C) (DIN 53504)
 - 4) Pull-off Strength (ASTM D4541): > 217 lbs./sq./in. (> 1.5 N/mm)
 - 5) Shore A Hardness (Resin): ~ 93 (14 days / +23°C) (DIN 53505)
 - 6) Elongation at Break (Resin): ~ 50% (14 days / +23°C) (DIN 53504)).

- b. Shock Pad: Sikafloor Comfort Regupol 6015H is a prefabricated rubber shockpad produced by bonding rubber crumb with a polyurethane compound. Sikafloor Comfort Regupol 6015H is rolled into the wet adhesive. Roll with a carpet roller.
 - c. Pore Sealer: Sikafloor Comfort Porefiller is a two part, total solid, low VOC, polyurethane. It is a flexible, durable high quality urethane compound used for sealing and levelling of the permeable surface of prefabricated granular rubber and foam pads with the following properties:
 - 1) Density: Mixed Resin: 11.05 lbs/gal. All Density values at 73.4°F (+23°C).
 - 2) VOC Content (ASTM D2369): 0 g/L
 - 3) Tensile Strength (ASTM D2370): 725.18 psi., 14 days / 73.4°F (~ 5.0 N/mm²) (14 days / +23°C) (DIN 53504)
 - 4) Shore A Hardness (Resin): ~ 89 @ 14 days / 73.4°F (+23°C) (DIN 53505)
 - 5) Elongation at Break (Resin): ~ 60% @ 14 days / 73.4°F (+23°C) (DIN 53504)).
 - d. Body Coat: Sikafloor 330 is an elastic, two part, solvent free, self leveling polyurethane resin system in [*Refer to Sika ComforFloor color chart*] color with the following properties:
 - 1) Density: Mixed Resin: 11.9 lbs./gal. All Density values at 73.4°F (23°C).
 - 2) VOC Content (ASTM D2369): 10 g/L
 - 3) Tensile Strength (ASTM D2370):Resin: 1,142 psi., 14 days / 73.4°F (~ 8.0 N/mm²)
 - 4) Pull-off Strength (ASTM D4541): > 400 psi (concrete failure)
 - 5) Shore A Hardness (Resin): ~ 80 (14 days / +23°C) (DIN 53505)
 - 6) Elongation at Break (Resin): ~ 180% (14 days / +23°C) (DIN 53504)
 - 7) Tear Growth Strength (Resin): 142.75 lbs/in (~ 25 N/mm 14 days / +23°C) (ISO 34-1)
 - 8) Approval / Standards: Fire classification acc. to EN 13501-1, Test report 08-199, Universiteit Gent
 - e. Top Coat / Color Sealer: Sikafloor 305W is a two part waterbased, low VOC, polyurethane, pigmented matte topcoat for use with flexible membrane systems with the following properties:
 - f. Approval / Standards Fire classification acc. to EN 13501-1, Test report 08-199,Universiteit Gent
 - g. Density:
 - 1) Part R: 11.1 lbs./gal. (~ 1.33 kg/l)
 - 2) Part H: 9.43 lbs./gal. (~ 1.13 kg/l)
 - 3) Mixed Resin: 10.40 lbs./mixed gal. (~ 1.24 kg/l) (diluted with 5% Water)
 - 4) All Density values at +73 F (23°C).
 - h. VOC Content (ASTM D2369): 30 g/L.
4. Cove base: Epoxy mortar cove based.

B. RF-2:

1. MANUFACTURER

- a. Manufacturer shall be certified under ISO 9001: 2008 All liquid materials, including primers, resins, curing agents, finish coats, and sealants are manufactured and tested under an ISO 9001:2008 registered quality system. Contact: Ray VanZytveld 616 666 5942.

- b. Approved Manufacturer shall be Sika Corporation, Industrial Flooring, 201 Polito Avenue, Lyndhurst, NJ 07071, Phone 201.933.8800, Fax 201.933.6225, www.sikafloorusa.com

2. SYSTEM

- a. Resinous flooring system: Sikafloor 22NA PurCem is a self-leveling, medium to heavy duty, solid color, three-component, water dispersed polyurethane-based/cement and aggregate screed. Typically applied between 3/16 to 1/4 in (4.5 to 6 mm) thick. System to consist of the following components:
- b. Self-Leveling Mortar: Sikafloor 22NA PurCem applied between 3/16" - 1/4".
- c. Top Coat: Sikafloor 510 LPL applied at 16-20 mils.

3. MATERIALS

- a. Primer: Substrate priming is normally not required under typical circumstances. Substrate porosity/condition determines if primer/scratch coat is required
- b. Self-Leveling Mortar: Sikafloor-22NA PurCem is a self-levelling, medium to heavy duty, solid color, three-component, water dispersed polyurethane-based / cement and aggregate screed. It is designed to provide excellent resistance to abrasion, impact, chemical attack and other physical aggression. Sikafloor-22NA has the following properties:
 - 1) Softening Point: 266°F (130°C)
 - 2) Density (ASTM C905): 16.84 lb./US gal. (2.02 kg/L)
 - 3) Flow: Approx. 11.8 in (300 mm)
 - 4) Service Temperature: - 40°F (- 40°C) min. / 212°F (100°C) max.
 - 5) Compressive Strength (ASTM 579)
 - i. 24 hrs 3,191 psi (22 MPa)
 - ii. 7 days 5,366 psi (37 MPa)
 - iii. 28 days 5,802 psi (40 MPa)
- c. Tensile Strength (ASTM C307): 1,045 psi (6.5 MPa)
- d. Flexural Strength (ASTM C580): 2,314 psi (14.7 MPa)
- e. Pull-off Strength (ASTM D4541): > 254 psi (> 1.75 MPa) (substrate failure)
- f. Thermal Compatibility (ASTM C884): Pass
- g. Shore D Hardness (ASTM D2240): 80 - 85
- h. Indentation (MIL -PRF -24613): ~ 0%
- i. Impact Resistance (ASTM D2794): 5.02 ft - lb (6.81 joules) at 1/8" (3 mm) of thickness
- j. Abrasion Resistance (ASTM D4060): CS-17/1,000 cycles/2.2 lb (1,000 g) -0.0052 oz (-0.110 g)
 - 1) H-22/1,000 cycles/2.2 lb (1,000 g)-0.080 oz (- 2.26 g)
- k. Coefficient of Friction (ASTM D1894-61T):
 - 1) Steel 0.3
 - 2) Rubber 0.5
- l. Coefficient of Thermal Expansion (ASTM D696):
 - 1) 0.89 x 10⁻⁵ in/in/°F
 - 2) (1.6 x 10⁻⁵ mm/ mm/°C)
- m. Water Absorption (ASTM C413): 0.10%
- n. Flexural Modulus (ASTM C580): 629,025 psi (4,335.7 MPa)
- o. Resistance to Fungi Growth (ASTM G21): Rated 0 (no growth)
- p. Resistance to Mold Growth (ASTM D3273): Rated 10 (highest resistance)
- q. VOC's Components A+B+C: < 5 g/L

- 4. Broadcast Aggregate: Quartz aggregate.

5. Top Coat: Sikafloor 510 LPL is a two-component, solvent-free, high solids, low-viscosity, high strength, polyaspartic resin system in color indicated in drawings with the following properties:
 - a. Pull-off Strength (ASTM D1583): > 400 psi (2.7 MPa) with 100% concrete failure.
 - b. Shore D Hardness (ASTM D2240): 75.
 - c. VOC Content (ASTM D2369): ≤ 50 g/L.
 - d. Viscosity (approximately) of Components A + B: 850 cps.
 - e. Tensile Strength (ASTM C307): 6,500 psi.
 - f. Coefficient of Friction (ASTM D1894): 61T 0.8.
 6. Cove base: Polyurethane mortar cove based, 4 inch.
- C. Retain "System Physical Properties" Paragraph below and insert values to establish criteria for system physical properties if required. Manufacturers' testing procedures differ; revise test methods indicated and insert additional requirements to suit Project.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Prepare and clean substrates according to resinous flooring manufacturer's written instructions for substrate indicated. Provide clean, dry substrate for resinous flooring application.
- B. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.
 1. Roughen concrete substrates as follows:
 - a. Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
 - b. Comply with ASTM C 811 requirements unless manufacturer's written instructions are more stringent.
 2. Repair damaged and deteriorated concrete according to resinous flooring manufacturer's written instructions.
 3. Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.
 - a. Anhydrous Calcium Chloride Test: ASTM F 1869. Proceed with application of resinous flooring only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) of slab area in 24 hours.
 - b. Plastic Sheet Test: ASTM D 4263. Proceed with application only after testing indicates absence of moisture in substrates.
 - c. Relative Humidity Test: Use in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
 4. Alkalinity and Adhesion Testing: Verify that concrete substrates have pH within acceptable range. Perform tests recommended by manufacturer. Proceed with application only after substrates pass testing.
- C. Patching and Filling: Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.

- D. Resinous Materials: Mix components and prepare materials according to resinous flooring manufacturer's written instructions.

3.2 APPLICATION

- A. Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.
 - 1. Expansion and Isolation Joint Treatment: At substrate expansion and isolation joints, comply with resinous flooring manufacturer's written instructions.
- B. Primer: Apply primer over prepared substrate at manufacturer's recommended spreading rate.
- C. Reinforcing Membrane: Apply reinforcing membrane to substrate cracks.
- D. Integral Cove Base: Apply cove base mix to wall surfaces before applying flooring. Apply according to manufacturer's written instructions. Round internal and external corners.
 - 1. Integral Cove Base: 4 inches (100 mm) high.
- E. Self-Leveling Body Coats: Apply self-leveling slurry body coats in thickness indicated for flooring system.
 - 1. Aggregates: Broadcast aggregates at rate recommended by manufacturer and, after resin is cured, remove excess aggregates to provide surface texture indicated.
- F. Troweled or Screeded Body Coats: Apply troweled or screeded body coats in thickness indicated for flooring system. Hand or power trowel and grout to fill voids. When body coats are cured, remove trowel marks and roughness using method recommended by manufacturer.
- G. Grout Coat: Apply grout coat, of type recommended by resinous flooring manufacturer, to fill voids in surface of final body coat.
- H. Topcoats: Apply topcoats in number indicated for flooring system and at spreading rates recommended in writing by manufacturer and to produce wearing surface indicated.
- I. Protect resinous flooring from damage and wear during the remainder of construction period.

END OF SECTION 096723

SECTION 097200 - WALL COVERINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. 051213 - Architecturally Exposed Structural Steel Framing

1.2 SUMMARY

- A. Section Includes:
 - 1. Vinyl wall covering.

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 data on physical characteristics, durability, fade resistance, and fire-test-response characteristics.
- B. Shop Drawings: Show location and extent of each wall-covering type. Indicate pattern placement seams and termination points.
- C. Samples: Submit manufacturer's samples.

1.5 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each wall covering, for tests performed by a qualified testing agency.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For wall coverings to include in maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same production run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Wall-Covering Materials: For each type, color, texture, and finish, full width by length to equal to 5 percent of amount installed.

1.8 QUALITY ASSURANCE

- A. **Mockups: Wrap partial column onsite to verify selections made under Sample submittals and to demonstrate aesthetic effects and to set quality standards for installation.**
 - 1. Mock up on each substrate required. Comply with requirements in ASTM F1141 for appearance shading characteristics.
 - 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 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install wall coverings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and HVAC system is operating and maintaining ambient temperature and humidity conditions at levels intended for occupants after Project completion during the remainder of the construction period.
- B. Ventilation: Provide continuous ventilation during installation and for not less than the time recommended by wall-covering manufacturer for full drying or curing.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: As determined by testing identical wall coverings applied with identical adhesives to substrates in accordance with test method indicated below by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: 25 or less.

- b. Smoke-Developed Index: 45 or less.

2.2 VINYL WALL COVERING

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. 3M DI-NOC Metallic - as indicated on drawings
- B. Description: Provide vinyl products in rolls from same production run and complying with the following:
 - 1. Wallcovering Association's W-101 for Type II, Medium Duty.
 - 2. ASTM F793/F793M for wall coverings.
 - a. Category: II, Decorative with Medium Serviceability
- C. Total Weight: 1.24 ounces/square foot
- D. Width: 48" inches.
- E. Backing: Acrylic pressure sensitive adhesive
- F. Mildew Resistance: Rating of zero or 1 when tested in accordance with ASTM G21.

END OF SECTION 097200

SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes all labor, materials, tools and other equipment, services and supervision required to complete all interior and exterior painting work, including:
 - 1. Moisture testing of substrates.
 - 2. Surface preparation of all new and existing substrates as required for acceptance of paint, including cleaning, small crack repair, patching, caulking, and making good surfaces and areas to the limits defined under the MPI Preparation requirements.
 - 3. Sealing or priming of all new and existing surfaces for repainting per MPI requirements.
 - 4. Provision of safe and adequate ventilation as required over and above temporary ventilation supplied by others, where toxic and/or volatile/flammable materials are being used.

1.2 DEFINITIONS

- A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. MPI Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- C. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- D. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
- E. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
 - 1. Include Printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
- B. Samples: For each type of paint system and in each color and gloss of topcoat. Provide Draw-downs for each paint type as indicated in drawings.

1.4 QUALITY ASSURANCE

- A. All materials, preparation and workmanship shall conform to requirements of the latest edition of the Architectural Painting Specification Manual by the Master Painters Institute (MPI).
- B. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Architect will select one surface to represent surfaces and conditions for application of each paint system.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
 - b. Other Items: Architect will designate items or areas required.
 - 2. Final approval of color selections will be based on mockups.
 - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

- C. All surfaces requiring repainting shall be inspected by the Painting Contractor who shall notify the Architect and General Contractor in writing of any defects or problems, prior to commencing repainting or after preparation work.

1.5 PROJECT CONDITIONS

- A. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F. Maintain storage containers in a clean condition, free of foreign materials and residue.
- B. Apply waterborne paints only when temperatures of surfaces to be painted and surrounding air are between 50 and 90 deg F.
- C. Apply solvent-thinned paints only when temperatures of surfaces to be painted and surrounding air are between 45 and 95 deg F.
- D. Do not apply paint when relative humidity exceeds 85 percent; or at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide products indicated in finish systems schedules or comparable products by one of the following:
 - 1. Basis-of-Design: Sherwin Williams.
 - 2. Benjamin Moore.
 - 3. PPG Industries.
 - 4. Pratt & Lambert.
 - 5. Substitutions: See Section 012500 - Substitution Procedures.

2.2 PAINT, GENERAL

- A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."
- B. Material Compatibility:
 - 1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
- C. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction.
- D. Colors: Provide colors in accordance with University Master Interior Paint Color Palette, based on Sherwin-Williams colors. Refer to Drawings for color selections.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Prior to commencement of Work, thoroughly examine (and test as required) all interior conditions and surfaces scheduled to be painted / repainted and report in writing to the Owner and General Contractor any conditions or surfaces that will adversely affect work of this section.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - 1. Concrete: 12 percent.
 - 2. Masonry (CMUs): 12 percent.
 - 3. Gypsum Board: 12 percent.

- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Proceed with coating application only after unsatisfactory conditions have been corrected.
 - 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" and "MPI Repainting Manual" applicable to substrates and paint systems indicated.
- B. Prepare all surfaces in accordance with MPI requirements.
- C. Sand, clean, dry, etch, neutralize and/or test all surfaces under adequate illumination, ventilation and temperature requirements.
- D. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- E. Protect all adjacent interior surfaces and areas, including door hardware and rating and instruction labels on doors, frames, equipment, piping, etc., from painting and repainting operations and damage by drop cloths, shields, masking, templates, or other suitable protective means and make good any damage caused by failure to provide such protection.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".
- B. Sand and dust between each coat to provide an anchor for next coat and to remove defects in previous coat (runs, sags, etc.) visible from a distance up to 1000 mm (39 inches).
- C. Do not apply finishes on interior surfaces that are not sufficiently dry. Unless manufacturer's directions state otherwise, each coat shall be sufficiently dry and hard before a following coat is applied.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.4 INTERIOR PAINTING SCHEDULE

- A. CMU Substrates: All exposed CMU construction.
 - 1. Latex System MPI INT 4.2A: All spaces unless noted otherwise.
 - a. Block Filler: Block filler, latex, interior/exterior, MPI #4.
 - 1) Benjamin Moore: Ultra Spec Int/Ext High-Build Block Filler 571/K571.
 - 2) PPG: Glidden Concrete Coatings Block Filler Int/Ext Primer 3010-1200.
 - 3) S-W: Loxon Block Surfacer B42 Series
 - 4) Substitutions: See Section 012500 - Substitution Procedures.
 - b. Intermediate Coat: Latex, interior, matching topcoat.
 - c. Topcoat: Latex, interior (MPI Gloss Level 3), MPI #52.
 - 1) Benjamin Moore: Super Hide Zero VOC Interior Eggshell.
 - 2) PPG: Speedhide Zero Interior Zero VOC Latex Satin.
 - 3) S-W: ProMar 200 Zero VOC Interior Latex Eggshell.
 - 4) Substitutions: See Section 012500 - Substitution Procedures.
 - d. Existing Masonry Primer Coat:
 - 1) S-W: Loxon Concrete and Masonry Primer, LX02 Series
 - 2) Substitutions: See Section 012500 - Substitution Procedures.

- B. Steel Substrates: Metal doors and frames and other steel surfaces.
1. Institutional Low-Odor/VOC Latex System MPI INT 5.1S:
 - a. Prime Coat: Primer, rust inhibitive, water based MPI #107.
 - 1) Benjamin Moore: Super Spec HP D.T.M. Acrylic Low Lustre P25.
 - 2) PPG: Pitt-Tech Plus Int/Ext DTM Industrial Primer 90-909.
 - 3) S-W: Pro Industrial Pro-Cryl Universal Primer, B66-310 Series.
 - 4) Substitutions: See Section 012500 - Substitution Procedures.
 - b. Topcoats: Latex, interior, institutional low odor/VOC (MPI Gloss Level 5), MPI #147.
 - 1) Benjamin Moore: Ultra Spec 500 Zero VOC Interior Gloss Finish N540.
 - 2) PPG: Glidden Diamond 450 No VOC Interior Semi-Gloss 7400N.
 - 3) S-W: Pro Industrial Acrylic Gloss Coating, B66-660 Series.
 - 4) Substitutions: See Section 012500 - Substitution Procedures.
 2. Water-Based Dry-Fall System MPI INT 5.1C:
 - a. Prime Coat: Shop primer specified in Section where substrate is specified.
 - b. Topcoat: Dry fall, latex, flat, MPI #118.
 - 1) Benjamin Moore: Super Kote 5000 Dry Fall Acrylic Latex N110.
 - 2) PPG: Glidden Professional Waterborne Flat Dryfall 1280.
 - 3) S-W: Pro Industrial Waterborne Acrylic Dry Fall B42W00181.
 - 4) Substitutions: See Section 012500 - Substitution Procedures.
- C. Gypsum Board Substrates:
1. Latex over Latex Sealer System MPI INT 9.2A:
 - a. Prime Coat: Primer sealer, MPI #50.
 - 1) Benjamin Moore: Ultra Spec 500 Zero VOC Interior Latex Primer N534.
 - 2) PPG: Speedhide Zero Interior Zero VOC Latex Sealer 6-4900XI.
 - 3) S-W: ProMar 200 Zero VOC Latex Primer, B28W2600.
 - 4) Substitutions: See Section 012500 - Substitution Procedures.
 - b. Intermediate Coat: Latex, interior, matching topcoat.
 - c. Topcoat: Latex, interior (MPI Gloss Level 3), MPI #52.
 - 1) Benjamin Moore: Ultra Spec 500 Zero VOC Interior Eggshell Finish N538.
 - 2) PPG: Glidden Diamond 350 Interior Eggshell 1403.
 - 3) S-W: ProMar 200 Zero VOC Latex Egg-Shell, B20-2600 Series.
 - 4) Substitutions: See Section 012500 - Substitution Procedures.
- D. Wet Areas (shower rooms, changing areas, toilet rooms, janitors closets, front kitchen):
- One component Epoxy Paint - Color indicated on drawings.
1. CMU, New/Bare
 - a. Prime Coat: Pro Industrial Heavy Duty Block Filler, B42 Series
 - b. Intermediate Coat: Pro Industrial Pre Catalyzed Waterbased Epoxy K46 Semi-gloss
 - c. Topcoat: Pro Industrial Pre Catalyzed Waterbased Epoxy K46 Semi-gloss
 - d. Substitutions: See Section 012500 - Substitution Procedures.
 2. CMU /Brick, previously painted
 - a. Primer: PrepRite ProBlock Latex, B51 Series
 - b. Intermediate Coat: Pro Industrial Pre Catalyzed Waterbased Epoxy K46 Semi-gloss
 - c. Topcoat: Pro Industrial Pre Catalyzed Waterbased Epoxy K46 Semi-gloss
 - d. Substitutions: See Section 012500 - Substitution Procedures.

3. Gypsum Board
 - a. Walls:
 - 1) Primer: PrepRite ProBlock Latex, B51 Series
 - 2) Intermediate Coat: Pro Industrial Pre Catalyzed Waterbased Epoxy K46 Semi-gloss
 - 3) Topcoat: Pro Industrial Pre Catalyzed Waterbased Epoxy K46 Semi-gloss
 - 4) Substitutions: See Section 012500 - Substitution Procedures.
 - b. Ceilings:
 - 1) Primer: PrepRite ProBlock Latex, B51 Series
 - 2) Intermediate Coat: Pro Industrial Pre Catalyzed Waterbased Epoxy K46 Semi-gloss
 - 3) Topcoat: Pro Industrial Pre Catalyzed Waterbased Epoxy K46 Semi-gloss
 - 4) Substitutions: See Section 012500 - Substitution Procedures.

END OF SECTION 099123

SECTION 099600 - HIGH-PERFORMANCE COATINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes surface preparation and the application of high-performance coating systems on the following substrates:
 - 1. Exterior Metal Substrates.

1.2 DEFINITIONS

- A. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
- B. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
- C. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
- B. Samples: For each type of coating system and in each color and gloss of topcoat indicated. Sample should include full finish on a 24" x 24" panel matching what will be the final substrate for applied finishes.

1.4 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each coating system indicated to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Architect will select one surface to represent surfaces and conditions for application of each coating system.
 - a. Wall and Ceiling Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
 - b. Other Items: Architect will designate items or areas required.
 - 2. Final approval of color selections will be based on mockups.
 - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the products listed in the High-Performance Coating Schedule for the coating category indicated.

2.2 HIGH-PERFORMANCE COATINGS, GENERAL

- A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."
- B. Material Compatibility:
 - 1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
 - 3. Products shall be of same manufacturer for each coat in a coating system.
- C. Colors: As selected by Architect.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for conditions affecting performance of the Work.
- B. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- C. Proceed with coating application only after unsatisfactory conditions have been corrected.
 - 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and coating systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of coatings, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce coating systems indicated.

3.3 APPLICATION

- A. Apply high-performance coatings according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."
- B. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.

3.4 EXTERIOR HIGH-PERFORMANCE COATING SCHEDULE

- A. Metal Substrates: Exposed structural steel, decorative metal ornaments, doors and window frames. Color as indicated on drawings.
 - 1. Polyurethane over Epoxy System:
 - a. Basecoat: Epoxy, High Build, Low Gloss.
 - 1) AzkoNobel: Devoe Bar Rust 235.
 - 2) PPG: Protective & Marine Aquapon High Build Epoxy.
 - 3) S-W: Protective & Marine Macropoxy 646 FC.
 - 4) Substitutions: See Section 012500 - Substitution Procedures.
 - b. Intermediate Coat: Polyurethane, matching topcoat.
 - c. Topcoat: Two-part Polyurethane, Semi-Gloss.
 - 1) AzkoNobel: Devoe Devthane 379.
 - 2) PPG: Protective & Marine Pitthane Ultra Gloss, 95-812 Series.
 - 3) S-W: Protective & Marine Hi-Solids Polyurethane, B65-350.
 - 4) Substitutions: See Section 012500 - Substitution Procedures.

END OF SECTION 099600

SECTION 099770 - SHOP APPLIED COATINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Powder coating applied to metal surfaces.
- B. Refer to Schedule at end of section.

1.2 RELATED SECTIONS

- A. Section 01330 - Submittal Procedures.
- B. Section 012500 - Product Requirements, Substitutions.
- C. Section 05120 - Structural Steel: Substrate surfaces requiring powder coatings.
- D. Section 05500 - Metal Fabrications: Substrate surfaces requiring powder coatings.
- E. Section 09900 - Paints and Coatings: Paint coatings over other metal surfaces.

1.3 REFERENCES

- A. American Society for Testing and Materials (ASTM)
 - 1. ASTM B117 - Practice for Operating Salt Spray (Fog) Apparatus.
 - 2. ASTM D522 - Test Methods for Mandrel Bend Test of Attached Organic Coatings.
 - 3. ASTM D523 - Test Method for Specular Gloss.
 - 4. ASTM D609 - Practice for preparation of Cold-Rolled Steel Panels for Testing Paint, Varnish, Coatings, and related Coating Products
 - 5. ASTM D610 - Test method for Evaluating Degree of Rusting on Painted Steel Surfaces
 - 6. ASTM D714 - Test Method for Evaluating Degree of Blistering of Paints.
 - 7. ASTM D968 - Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive.
 - 8. ASTM D1014 - Practice for Conducting Exterior Exposure Tests of Paintson Steel.
 - 9. ASTM D1400 - Test Method for Nondestructive Measurement of Dry Film Thickness of Nonconductive Coatings Applied to a Nonferrous MetalBase.
 - 10. ASTM D1654 - Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments.

11. ASTM D1729 – Practice for Visual Appraisal of Colors and Color Differences of Diffusely Illuminated Opaque Materials.
12. ASTM D1730 – Practices for Preparation of Aluminum and Aluminum-Alloy Surfaces for Painting.
13. ASTM D1735 – Practice for Testing Water Resistance of Coatings Using Water Fog Apparatus
14. ASTM D2244 – Test Method for Calculation of Color Differences from Instrumentally Measured Coordinates.
15. ASTM D2247 – Practice for Testing Water Resistance of Coatings in 100% Relative Humidity.
16. ASTM D2794 – Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
17. ASTM D3359 – Test Methods for Measuring Adhesion by Tape Test.
18. ASTM D3363 – Test Method for Film Hardness by Pencil Test.
19. ASTM D3451 – Practices for Testing Polymeric Powders and Powder Coatings.
20. ASTM D4214 – Test Method for Evaluating Degree of Chalking of Exterior Paint Films.
21. ASTM D5382 – A Guide to Evaluation of Optical Properties of Powder Coatings.
22. ASTM D5861 – Guide to Significance or Particle Size Measurements of Coating Powders.
23. ASTM D6441 – Test Methods for Measuring the Hiding Power of Powder Coatings.
24. ASTM E284 – Terminology of Appearance
25. ASTM E1164 – Practice for Obtaining Spectrophotometric Data for Object-color Evaluation

B. International Organization for Standardization (ISO)

1. ISO 1519 - Paints and varnishes - Bend test (cylindrical mandrel).
2. ISO 1520 - Paints and varnishes - Cupping test.
3. ISO 2409 - Paints and varnishes - Cross-cut test.
4. ISO 2815 - Paints and varnishes - Buchholz indentation test.

1.4 SUBMITTALS

A. Submit product data in accordance with Section 01330 - Submittal Procedures.

B. Submit full records of all products used. List each product in relation to finish formula and include the following:

1. Product type and use.
2. Manufacturer's product number.

3. Color numbers or descriptions.
 4. Manufacturer's Material Safety Data Sheets (MSDS)
 - C. Submit manufacturer's application instructions for each product specified.
 - D. Submit certification that all materials have been applied in accordance with the coating manufacturer's recommendations.
- 1.5 SAMPLES
 - A. Submit duplicate 300 x 200 mm sample panels of each finish type, color, and texture specified.
 - B. Submit full range of available colors where color availability is restricted.
 - C. Use 1.5 mm (14 gage) steel q-panels for sample finish.
- 1.6 QUALITY ASSURANCE
 1. Standard of Acceptance:
 - a. Final coat to exhibit uniformity of color and uniformity of gloss across full surface area.
 - b. Quality of coated products to conform to specified requirements.
- 1.7 DELIVERY, STORAGE AND HANDLING
 - A. Deliver, store, handle and protect coated materials in accordance with Section 01400 - Product Requirements.
 - B. Deliver and store materials in original packaging, sealed, with labels intact. (see Product Descriptions)
 - C. Indicate on containers or wrappings:
 1. Manufacturer's name and address.
 2. Type of coating.
 3. Color number in accordance with established color schedule.
 4. Batch number.
 - D. Provide and maintain dry, temperature controlled, secure storage.
- 1.8 ENVIRONMENTAL REQUIREMENTS
 - A. Maintain substrate and ambient temperature limits required by coating manufacturer.
 - B. Apply coating only when surface to be coated is dry and adequately pre-treated.
- 1.9 SCHEDULING

- A. Submit work schedule for various stages of coating application.
- B. Submit schedule minimum 48 hours in advance of operations.

PART 2 PRODUCTS

2.1 MANUFACTURER

- A. TIGER Drylac® U.S.A., Inc., 3945 Swenson Ave., St Charles, Illinois 60174; Phone (800) 243-8148, Fax (877) 926-8148; E-mail: TAS@tiger-coatings.us. Website: www.tiger-coatings.com.
- B. Substitutions: Refer to Section 012500.
- C. Coating to be applied by an applicator with the appropriate facilities (spray equipment, oven, controlled environment, etc...)

2.2 MATERIALS

- A. Powder Coating: Epoxy or Epoxy/Polyester hybrid resin-based thermosetting powder, Series 09 or 89, standard grade Epoxy or Epoxy/Polyester Hybrid for Interior applications.

2.3 COLORS

- A. Selection of colors from manufacturers full range of colors. Color Schedule provided by Consultant after contract award.
- B. Smooth Glossy Finish Colors: Full range of standard RAL colors as supplied by TIGER Drylac U.S.A., Inc.
- C. Smooth Semi-Gloss Colors: 15 Standard RAL colors. Contact TIGER Drylac U.S.A., Inc. for details
- D. Smooth Matte Finish Colors: 19 Standard RAL colors. Contact TIGER Drylac U.S.A., Inc. for details
- E. Rough Texture Glossy Colors: 26 Standard RAL colors. Contact TIGER Drylac U.S.A., Inc. for details
- F. Rough Texture Matte Colors: 23 Standard RAL colors. Contact TIGER Drylac U.S.A., Inc. for details
- G. Fine Texture Colors: 27 Standard RAL colors. Contact TIGER Drylac U.S.A., Inc. for details
- H. HammerTone Colors: 24 Standard NON-RAL colors. Contact TIGER Drylac U.S.A., Inc. for details
- I. Metallics/Antiques/Vein Colors: 16 standard Non-RAL colors. Contact TIGER Drylac U.S.A., Inc. for details

2.4 COATING FINISHES

A. Shop primed ferrous metal surfaces:

1. Thermosetting Polyester/Epoxy Resin-based Powder. Finish coat: Any in section 2.3

B. Galvanized and zinc coated metal surfaces:

1. Thermosetting Polyester/Epoxy Resin-based Powder. Finish coat: Any in section 2.3
2. Aluminum surfaces:
3. Pre-treat to ASTM D1730 Type B, Method 5 using a multi-stage chromate process or an approved chrome-free pretreatment process approved by Powder coating manufacturer for optimized weather resistance. Other pre-treatment options may be available based on product end-use requirements.
4. Thermosetting Polyester/Epoxy Resin-based Powder, Finish coat: Any in section 2.3

PART 3 EXECUTION

3.1 PREPARATION

- A. Grind fabrication welds smooth.
- B. Clean surfaces prior to pretreatment coating.
- C. Surfaces to Receive Finishes: Dry and free of debris, oils, dust, or other deleterious materials.

3.2 CLEANING

- A. Clean surfaces to be coated as follows:
 1. Remove all dust, dirt, and other surface debris by vacuuming, wiping dry with clean cloths or compressed air.
 2. Rinse scrubbed surfaces with clean water until foreign matter is flushed from surface.
 3. Allow surfaces to drain completely and allow to thoroughly dry.
- B. If the above procedures do not clean the substrate surfaces, clean the surfaces with high pressure water washing.
- C. Apply pretreatment as soon as possible after cleaning and before surface deterioration occurs.
- D. Pre-treat iron phosphate for steel, zinc phosphate for galvanized or steel structures, and yellow or green chromating, or approved chrome-free for aluminum substrates.

3.3 APPLICATION

- A. Apply coating to requirements of coating manufacturer's written application instructions.
- B. Method of Application: Electrostatic manual spraying.
- C. Spray application.
 - 1. Provide and maintain equipment that is suitable for intended purpose, capable of properly fluidizing powder coating to be applied.
 - 2. Apply coating materials to clean surfaces to minimum 2.5 - 3.5 mil dry film thickness or as specified by manufacturer.
 - 3. Ensure coating adheres to internal corners and recessed areas.
- D. Allow surfaces to cure for minimum time period as required by manufacturer.
- E. Cure in accordance with manufacturer's cure curves.

3.4 FIELD QUALITY CONTROL

- A. Field inspection of coating operations to be performed by a designated independent inspection firm.
- B. Advise when each applied coating is ready for review.

3.5 SCHEDULE

- A. Structural Columns - Tubular Steel, Interior: As indicated in drawings.

END OF SECTION 099770

SECTION 10 1400 - SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

- A. Room and door signs.
- B. Dimensional characters.

1.2 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design 2010.
- B. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate 2014.
- C. ICC A117.1 - Accessible and Usable Buildings and Facilities 2017.

1.3 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's data on each type of sign.
- C. Shop Drawings: For each sign type, provide dimensioned elevation including letter sizes and locations, graphics, colors and finishes, mounting methods, mounting heights, and material descriptions.
- D. Signage Schedule: Provide information sufficient to completely define each sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts, and colors.
 - 1. When room numbers to appear on signs differ from those on drawings, include the drawing room number on schedule.
 - 2. When content of signs is indicated to be determined later, request such information from Owner through Architect at least 2 months prior to start of fabrication; upon request, submit preliminary schedule.
 - 3. Submit for approval by Owner through Architect prior to fabrication.
- E. Samples:
 - 1. Room and Door Signs: Submit 2 samples of each type of sign construction, of size similar to that required for project, illustrating sign style, font, colors, and method of attachment.
 - 2. Dimensional Characters: Submit 2 samples, full size, of each dimensional character style, font, color, and method of attachment.
 - a. For specified sizes 12 inches and under, provide samples matching specified size.
 - b. For specified sizes over 12 inches, provide 12 inch high samples unless actual specified size requested by Architect.
 - 3. Plaques: Provide samples upon Architect's request.
- F. Verification Samples: Submit samples showing colors specified.
 - 1. Where colors are not specified, submit two sets of color selection charts or chips.
- G. Maintenance Data: Include data on regular cleaning.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Company experienced in installing the products specified in this section with minimum 5 years documented experience.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Package signs as required to prevent damage before installation.
- B. Store tape adhesive at normal room temperature.

1.6 FIELD CONDITIONS

- A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.
- B. Maintain this minimum temperature during and after installation of signs.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Room and Door Signs (Acrylic):
 - 1. Chemcast
 - 2. Substitutions: See Section 01 2500 - Substitution Requirements.
- B. Dimensional characters:
 - 1. Gemini Inc.: www.geminisignproducts.com.
 - 2. Quality Manufacturing: www.qualitymanufacturing.com
 - 3. Substitutions: See Section 01 2500 - Substitution Requirements.

2.2 ROOM AND DOOR SIGNS

- A. Sign Type: Flat signs with dimensional raised panel media as specified. Tactile characters and Braille applied to the face of sign.
 - 1. Accessibility Compliance: Signs are required to comply with ADA Standards and ICC A117.1 and applicable building codes, unless otherwise indicated; in the event of conflicting requirements, comply with the most comprehensive and specific requirements.
 - 2. Provide "tactile" signage, with letters raised minimum 1/32 inch and Grade II braille.
- B. Materials:
 - 1. Typical Sign Material: Face material shall be .236" cast acrylic P95 green 3030 with opaque white vinyl film backer. Sign shall appear floating off wall created by .5" opaque white acrylic as noted on drawings. Insert only required as indicated in drawings.
 - a. Basis of Design:
 - 1) Chemcast Cast Acrylic P95 green 3030
 - 2) Substitutions: See Section 01 2500 - Substitution Requirements.
 - 2. Backing Plate: As indicated in drawings.
 - 3. Large 2' x 8' Acrylic Sign in Lobby: Face Material shall be .708 cast acrylic P95 green 3030 with opaque white vinyl film backer. Sign shall appear floating off wall created by 2" concealed stand offs.
 - 4.
- C. Sign Properties:
 - 1. Sign Sizes and Shapes: As indicated in drawings.
 - 2. Character and Graphic Layouts: As indicated in drawings.

3. Character Styles (Fonts): As indicated.
4. Character Sizes: As indicated.
5. Pictograms and Graphics: As indicated.
- D. Colors and Finish:
 1. First Background Colors: As indicated.
 2. Character Colors: As indicated.
 3. Pictograms and Graphics Colors: As indicated.
- E. Miscellaneous:
 1. Changeable Message Inserts: Manufacturer's standard "window" section for replaceable text inserts; provide where indicated.
 - a. Window shall have a transparent cover to protect changeable messages.
 - b. Windows shall accommodate printed paper.
- F. Mounting:
 1. Walls (Gypsum Board & Porcelain Tile): VHB Tape adhesive.
 2. Stone Veneer Walls: Mechanically fasten to the surface
 3. Glass: Tape adhesive with matching plate of same material as sign, on opposite side of glass to conceal mounting materials.
 4. Bracket-Mounted 2-Sided Signs - Walls and Ceilings: Aluminum wall bracket, powder coated, color selected from manufacturer's standard colors, attached with screws in predrilled mounting holes.
 5. Standoffs: Stainless steel 2" standoff with concealed hardware
- G. Locations - General:
 1. Provide a sign for every doorway, whether it has a door or not, not including corridors, lobbies, and similar open areas.

2.3 DIMENSIONAL CHARACTERS

- A. Metal Characters:
 1. Cast Aluminum Characters: Form individual characters by casting.
 - a. Fabricate characters with smooth surfaces and precisely formed profiles, lines, and edges; without pits and other imperfections. Cast lugs into back of characters and tap for threaded mounting studs.
 - b. Material:
 - 1) Aluminum: In alloy and temper as recommended by dimensional character manufacturer.
 - c. Depth: 1-1/2"
 - d. Character Styles (Fonts): As indicated.
 - e. Character Sizes: As indicated.
 - f. Finish: As indicated.
 - g. Mounting: Manufacturer's standard non-corrosive concealed studs (pin mounting). Provide fasteners as applicable for substrates indicated.
 - 1) Projected Mounting: Mount dimensional characters 1 inch off substrate; from face of substrate to back of dimensional character.
 2. Halo Lit Cast Aluminum Characters: Form individual characters by casting.
 - a. Aluminum: Alloy 514
 - b. LED Light: White
 - c. Depth: 1-1/2"
 - d. Finish: As indicated.
 - e. Mounting: Manufacturer's standard non-corrosive concealed studs (pin mounting). Provide Fasteners as applicable for substrates indicated.
 - 1) At exterior locations, provide stainless steel fasteners and hardware.
 - 2) substrate; from face of substrate to back of dimensional character.
 - 3) At exterior locations, provide stainless steel fasteners and hardware.

2.4 ACCESSORIES

- A. Tape Adhesive: Double sided tape, permanent adhesive.
 - 1. Acrylic, foam carrier, pressure-sensitive tapes with release liner for permanent bonding.
 - a. Products:
 - 1) 3M; VHB Tapes: www.3M.com.
 - (a) Provide specific VHB tape as recommended by tape manufacturer for applicable substrates.
 - 2) Substitutions: See Section 012500 - Substitution Procedures.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.

3.2 INSTALLATION

- A. General:
 - 1. Install in accordance with manufacturer's instructions.
 - 2. Install neatly, with horizontal edges level.
- B. Room and Door Signs:
 - 1. Mounting Locations: Unless otherwise indicated, mount signs as follows:
 - a. Locate signs and mount at heights indicated on drawings and in accordance with ADA Standards and ICC A117.1.
- C. Dimensional Characters:
 - 1. Mount dimensional characters at heights and locations indicated; with characters equally spaced unless otherwise indicated.
- D. Plaques:
 - 1. Mount plaques at heights and locations indicated.

3.3 CLEANING AND PROTECTION

- A. Clean signage as recommended by signage manufacturer.
- B. Protect from damage until Date of Substantial Completion; repair or replace damaged items.

END OF SECTION 101400

SECTION 10 14 63 - ELECTRONIC MESSAGE SIGNAGE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Indoor light emitting diode.

1.2 RELATED SECTIONS

- A. Section 10 14 00 - Signage.

1.3 REFERENCES

- A. Federal Communications Commission (FCC):
 - 1. FCC Part 15 Class A Complaint.
- B. Underwriters Laboratories (UL):
 - 1. UL48, CUL48, - Standard for Electric Signs,
 - 2. UL Energy Efficiency Verified (Green Leaf certification).
- C. National Electric Code (NEC).
- D. Uniform Building Code (UBC):
 - 1. UBC Standards.
- E. International Building Code (IBC):
 - 1. IBC Standards.
- F. American Society of Civil Engineers (ASCE):
 - 1. ASCE-7/16 Standard - Minimum Design Loads and Associated Criteria for Buildings and Other Structures.
- G. Intel and Digital Content Protection LLC:
 - 1. HDCP 2.x compliant.

1.4 SUBMITTALS

- A. Upon contract award, the LED display manufacturer shall provide a complete technical submittal within 60 days and shall not proceed with manufacturing until approval.
- B. Product Data:
 - 1. Manufacturer's data sheets on each product to be used.
 - 2. Preparation instructions and recommendations.
 - 3. Storage and handling requirements and recommendations.
 - 4. Site power requirements.
 - 5. LED display manufacturer qualifications, as specified herein.
 - 6. LED display installation drawing.
 - 7. LED display installation manual.
 - 8. LED display control software operator's manual.
 - 9. LED display installation and maintenance manual.
- C. Shop Drawings: Include details of materials, construction, and finish. Include relationship with adjacent construction.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section.
 - 1. Onsite quality assurance lab to verify product integrity.
 - 2. At least one Project Manager with PMI certification.
 - 3. A minimum of 75 years electrical sign manufacturing experience.
 - 4. A minimum of 20 years of LED display manufacturing experience prior to the contract bid date.
 - 5. A minimum of 50,000 permanently mounted LED displays in operation for a minimum period of one year prior to the contract bid date.
 - 6. Support via domestic, toll-free help desk and an online service knowledge base.
 - 7. Proof of liability coverage of \$10,000,000 aggregate.
- B. Manufacturing experience with the following types of electronic signs shall not satisfy the requirements:
 - 1. Matrix displays that show a limited quantity of messages.
 - 2. LCD displays.
 - 3. Back-lit displays.
- C. Installer Qualifications: Company specializing in performing Work of this section with minimum two years documented experience with projects of similar scope and complexity.
- D. Source Limitations: Provide each type of product from a single manufacturing source to ensure uniformity.

1.6 PRE-INSTALLATION CONFERENCE

- A. Convene a conference approximately two weeks before scheduled commencement of the Work. Attendees shall include Architect, Contractor and trades involved. Agenda shall include schedule, responsibilities, critical path items and approvals.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store and handle in strict compliance with manufacturer's written instructions and recommendations.
- B. Protect from damage due to weather, excessive temperature, and construction operations.

1.8 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

1.9 WARRANTY

- A. Manufacturer's standard limited warranty unless indicated otherwise.
 - 1. Warranty against material defects in material and workmanship for five years from the date of shipment from factory dock.
 - 2. Provide ten year parts guarantee with replacements reserved at time of

- purchase.
- 3. Replacement parts shipped the same day when requested by 3 p.m. CT.
- 4. Offer 5 percent spare parts.
- 5. Toll-free service coordination.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturer: Daktronics, Inc.
- B. Substitutions: See Section 012500 Substitution Procedures.

2.2 LED INDOOR DISPLAY

- A. Basis of Design: Daktronics
 - 1. Model X 1.2 mm. Technical Attributes.
 - a. Panel Resolution: 270 x 480.
 - b. Minimum Viewing Distance: 4 ft (1219 mm).
 - c. Pixel Density per Square Meter: 623,268.
 - d. Pixel Density per Square Foot: 57,900.
 - e. Power consumption: 0.002 W per pixel.
 - 2. Model X 1.5 mm. Technical Attributes.
 - a. Panel Resolution: 216 x 384.
 - b. Minimum Viewing Distance: 5 ft (1524 mm).
 - c. Pixel Density per Square Meter: 398,892.
 - d. Pixel Density per Square Foot: 37,056.
 - e. Power consumption: 0.0031 W per pixel.
 - 3. Model X 1.9 mm. Technical Attributes.
 - a. Panel Resolution: 180 x 320.
 - b. Minimum Viewing Distance: 6 ft (1829 mm).
 - c. Pixel Density per Square Meter: 277,008.
 - d. Pixel Density per Square Foot: 25,734.
 - e. Power consumption: 0.0045 W per pixel.
- B. Features: General.
 - 1. Viewing Angle: Vertical: 160 degrees. Horizontal: 170 degrees.
 - 2. Maximum Brightness: 600 nits. Adjustable.
 - 3. Pixel Configuration: Chip-on-Board 3-in-1.
 - 4. Color Calibration: Calibrated to D65 true white.
 - 5. Compliance Information: ETL 60950; RoHS; CE; FCC Part 15 regulations for Class A devices, HDCP 2.x.
 - 6. Ventilation: Rear.
 - 7. Thermal: Maximum: 2188 BTUs per square meter. Average: 7.34 BTUs.
 - 8. Panel Dimension (H x W): 13.46 x 23.94 inches (342 x 608 mm).
 - 9. Panel Construction: Modular; Die-cast aluminum.
 - 10. Panel Weight: 15 lbs (6.8 kg).
 - 11. Panel Depth: 2.95 inches (75 mm).
 - 12. Service Access: Front.
 - 13. Software: Proprietary Ignite; Integrates with digital signage players or scoring systems.
 - 14. Operating Temperature: 0 to 100 degrees F (-18 to 38 degrees).
 - a. Relative Humidity: 90 percent.
 - 15. Protection Grade: IP20.

16. User Interface: Web application and controller interface.
 17. Compatibility:
 - a. Graphics: JPG, GIF, PNG, BMP, and TGA.
 - b. Video: AVI, MOV, MP4, MPG, WMV; Options include DVI, HDMI inputs.
 18. Refresh Rate: 1920 to 3840 Hz.
 19. Video Input: DVI, HDMI.
 20. Warranty: 5 year parts and factory labor.
- C. LED Display:
1. Construction
 - a. Display Dimensions (H x W): 70 x 96 inches.
 - b. Front-to-Back Display Depth: 2.25 inches (57 mm). Not including mounting hardware.
 - c. A Full LED matrix: Pixel Rows High: 1080. Pixel Columns Wide: 1920.
 - d. Display Configuration: Single face and one sided.
 - e. The distance from the center of one line or column of pixels to the center of adjacent lines or columns:
 - 1) Model X 1.2 mm: 1.2 mm both horizontally and vertically.
 - f. Power Source: 240 VAC, 60 Hz single-phase, including neutral and ground.
 - g. Operating Temperature Range: 0 to 100 degrees F (-18 to 38 degrees C).
 - 1) Relative Humidity: 90 percent.
 - h. Internal Display Component Hardware: Fabricated from steel, aluminum, nylon, or other durable materials suitable for display application.
 - i. Module Components: 100 percent solid-state.
 - j. Display Performance: May not cause harmful radio, magnetic or electromagnetic interference. The display must accept any interference received, including interferences that may cause undesired.
 - 1) Noise Level: Not to exceed 30 dB.
 2. Exterior Finish: If required.
 - a. LED Display Border Pieces: Coated with a baked acrylic enamel.
 3. Serviceability:
 - a. Display Housing: Safe and convenient front service access for modular assemblies, components, wiring, and other materials located within the housing.
 - b. Internal Components: Replaceable by a single technician with proper tooling.
 - c. Service Access: By removal of one or more tiles in front of associated internal component.
 - d. Tiles: Allow removal with a tile removal tool.
 - e. Service features that minimize potential bodily harm.
- D. Display Components:
1. LED Display Tiles: Constructed for good readability, long life, and ease of service.
 - a. Panel Chassis Within the Product Family: Designed in the following sizes and grouped as necessary to form the overall display size.
 - 1) Tile Size: 14.46 x 24 inches (342 x 608 mm).
 - b. Tiles Within the Product Family: Designed with same physical footprint

- of 14.46 x 11.97 inches (342 x 304 mm).
- c. LED Tiles: Consist of LEDs with all drive electronics mounted on a single Printed Circuit Board (PCB).
 - 1) LEDs: To be auto inserted in order to maintain quality and uniformity of the LEDs within each LED tile.
 - 2) PCBs: Cleaned in a manner so as not to contain more than 2 parts per million contaminants.
- d. Tile Signal and Electrical Connections: Positive locking and removable.
 - 1) Module Removal from Display: Will not require a de-soldering operation.
- e. Redundant Data to Tiles: The signal reaches the module from multiple directions. In event of a signal path loss tiles still receive data.
 - 1) Failure of Pixel, Tile or Power Supply: Will not cause failure of any other pixel, module, or power supply in display if redundant data is present.
- f. LED Display Tiles in a Single Display:
 - 1) Identical in construction and interchangeable. Capable of being field calibrated.
 - 2) Tiles to be individually attached to the panel chassis.
 - 3) Removal of one or more tiles will not affect the display's structural integrity.
 - 4) Horizontal Half-Intensity Viewing Angle: 170 degrees.
- 2. Pixels: Constructed with 3 in 1 SMD LEDs and conform to the following:
 - a. LEDs: Diffused, ultra-bright, solid-state light emitting diodes.
 - b. Each Color of LEDs Used in LED Displays for Each Contract: Must come from the same product run.
 - c. LED Half-Life: Estimated 100,000 hours.
 - d. Display Maximum Intensity: 800 nits.
- 3. Power Supplies: Regulated, auto-ranging AC to DC power, with protection for the LED pixel, LED display, and driver circuitry in the event of power spikes or surges.
- 4. Internal Wiring and Components: Installed in housing in a neat manner.
 - a. Must not impede the removal of display modules, power supplies or other display components.
 - b. Conform to the National Electric Code.
 - c. Wires must not make contact with or be bent around sharp metal edges.
- 5. Display to be protected from electrical spikes and transients.
- 6. The display shall be compatible with the HDCP components.
- E. Display Performance:
 - 1. LED Display Capability:
 - a. Present continuous messages that are uniform in appearance.
 - b. Video and Message Files: Up to 60 frames per second playback capability.
 - c. Display messages composed of any combination of text, alphanumeric, symbols, graphic and video files.
 - d. Display Pixels: Composed of one each: Red, green, and blue LEDs configured in a Surface Mount Diode (SMD) pixel package.
 - e. Capable of producing 4.4 trillion colors for RGB at all dimming levels.
 - 2. Controller: Communication protocol supports other matrix products from the vendor such as other outdoor or indoor displays of varying sizes and/or colors. Move to software.

- a. Capable of receiving data by accessing the Ignite software using the following communication modes:
 - 1) Ethernet Fiber Optic.
 - 2) Ethernet Cat6 Wire.
- 3. Control and Communications:
 - a. Single-Face Displays: Controlled and monitored by its own LED controller.
 - b. Fiber: Single mode with LC connectors. Includes a dual connection from the controller to the display for every data path.
- F. Control Software:
 - 1. Control Software: Create, schedule, and deliver content via cloud-based software. Software to be hosted on manufacturer's servers at no cost to the customer.
 - a. Includes browser-based online editor for creating content, multiple content zones, and playlists.
 - b. Able to integrate widgets and RSS feeds.
 - c. Content Library: More than 1000 graphics and animations.
 - d. Smart Scheduling: Eliminates competing products to display in the same daypart.
 - e. Import and Store:
 - 1) Image Files: JPG, GIF, PNG, and TGA.
 - 2) Video Files: MP4 with HD 1080 capability.
 - 3) Audio Files: MP3, WAV and WMA audio files.
 - f. No annual Fee

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until the substrates have been properly constructed and prepared.
 - 1. Mounting Supports: To be installed to support displays.
 - 2. Separate Conduit for Power and Data to Display: To be in place unless fiber is being used. Verify control equipment has access to 120/240 VAC.
- B. If substrate preparation is the responsibility of another installer, notify Architect in writing of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions, approved submittals, and in proper relationship with adjacent construction.
 - 1. Support structure design depends on the mounting methods, display size,

and weight.

- a. Structure Design: Should be done only by a qualified individual.
2. The Contractor:
 - a. Is responsible to ensure the structure and mounting hardware are adequate.
 - b. Is responsible to ensure that the installation meets local standards.
3. Mounting Hardware: To be capable of supporting components to be mounted.
4. Possible power and signal entrances are designated by etched markings.
 - a. Separate conduit must be used to route the power, and data cables.
5. Displays must be grounded according to the provisions outlined in Article 250 of the National Electrical Code.
6. Installations are to conform to Article 600 of the National Electrical Code.

3.4 FIELD QUALITY CONTROL

- A. Field Inspection: Coordinate field inspection in accordance with appropriate sections in Division 01.
- B. Manufacturer's Services: Coordinate manufacturer's services in accordance with appropriate sections in Division 01.

3.5 CLEANING AND PROTECTION

- A. Clean products in accordance with the manufacturer's recommendations.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 102814 - ADULT CHANGING STATIONS

PART 1: GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Adjustable-Height Adult-Changing Station
 - 2. Wall mounted Privacy Screen

1.2 RELATED REQUIREMENTS

- A. Section 061000 - Rough carpentry, blocking in walls.
- B. Section 092100 - Plaster and gypsum board assemblies, blocking in walls.
- C. Section 093000 - Tiling, coordination with tile layout and installation.
- D. Section 260000 - Electrical service installation.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's data sheets for each product specified, including the following.
 - 1. Installation instructions and recommendations, including templates and rough-in measurements.
 - 2. Storage and handling requirements and recommendations.
 - 3. Cleaning and maintenance instructions.

1.4 QUALITY ASSURANCE

- A. Manufacturer: Provide products manufactured by a company with a minimum of 5 years successful experience manufacturing similar products.
- B. Accessibility Requirements: Comply with requirements applicable in the jurisdiction of the project, including but not limited to ADA, ICC A117.1 International Building Code (IBC), and state building code requirements as applicable.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store and handle materials and products in strict compliance with manufacturer's instructions and recommendations. Protect from damage.

1.6 WARRANTY

- A. Manufacturer's Warranties: Submit manufacturer's standard 3 year warranty for materials and workmanship.

PART 2: PRODUCTS

2.1 MANUFACTURER

- A. Basis of Design Products: As noted below.
- B. Substitutions: The Architect will consider products of comparable manufacturers as a substitution, pending the contractor's submission of adequate documentation of the substitution in accordance with procedures in Division 1 of the Project Manual. See Section 012500 - Substitution Procedures.

2.2 ADULT CHANGING STATIONS, HEIGHT-ADJUSTABLE

- A. Surface-Mounted Adjustable Height Changing Station :
 - 1. Basis of Design: Model KB3000-AHL as manufactured by Koala Kare Products, a Division of Bobrick.
 - 2. Powered-Height Adjustability: Changing surface shall electronically adjust from 12" (300mm) to 41" (1,041mm) from floor.
 - 3. Unit shall have two sets of built-in electronic controls for height adjustment. One located on face of wall cover and one on the front of changing surface.
 - 4. Weight Capacity: Tested to support up to 500 lbs. (227 kg.) static load.
 - 5. Changing Surface shall be polyethylene and meet IK10 standard for resistance to high impact and sharp objects.
 - 6. Back-Up Battery: Unit shall have a built-in backup battery system that allows for continuous operation in the event of a power interruption.
 - 7. Emergency Stop: Unit shall include a wall-mounted emergency stop to break power to actuator.
 - 8. Changing Surface shall be a minimum 75 ¼" (1,911mm) long, and 31 ½" (800mm) wide, and can be opened and closed with one-hand.
 - 9. Unit shall have a safety rail with a curved dip in the center for easier patient changing by caregiver. Safety rail rotates and locks under changing bed when in closed position.
 - 10. Unit shall withstand significant exposure to water without damage to electrical components. It shall include a grounded power cord and have a splash-proof control system. Electrical components and wiring shall not come in contact with station users or caregivers.
 - 11. Changing surface shall not have covered areas to help ensure cleanliness.
 - 12. Unit shall have ISO 60601-1 and -2 whole product certification.
 - 13. Durability: Cycle tested through range of motion 28,000 times at 500lbs. Stress tested to 100,000 cycles with 500lbs. bounce load test.
 - 14. Frame shall be constructed of 2" powder coated steel tubing.

2.3 PRIVACY FOLDING SCREEN (SP-04)

- A. Basis of Design: Silentia Screen: Folding screen 7 panels; Wall mounted
 - 1. Length: 5'-9" = 7 panels
 - 2. Height: 5'-5"
 - 3. Depth Folded: 5.5"
 - 4. Width Folded: 9.8"

PART 3: EXECUTION

3.1 INSTALLATION

- A. Install products in strict compliance with manufacturer's written instructions and recommendations, including the following:
 - 1. Verify wall blocking has been installed properly.
 - 2. Verify required electrical services have been installed properly.
 - 3. Verify wall location does not interfere with door swings or use of fixtures.
 - 4. Use fasteners and anchors suitable for wall substrate and project conditions.
 - 5. Install units at location and height indicated on the drawings.
 - 6. Install units level, plumb, and in proper relationship with adjacent construction.
 - 7. Adjust for proper operation.

3.2 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before substantial completion.

END OF SECTION

SECTION 102113 - PHENOLIC TOILET COMPARTMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Phenolic toilet compartments.
- B. Phenolic urinal screens.
- C. Phenolic entrance screens

1.2 RELATED REQUIREMENTS

- A. Section 051200 - Structural Steel Framing: Concealed steel support members.
- B. Section 055000 - Metal Fabrications: Concealed steel support members.
- C. Section 061000 - Rough Carpentry: Blocking and supports.
- D. Section 102800 - Toilet, Bath, and Laundry Accessories

1.3 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications; 2023a.
- C. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless-Steel Sheet, Strip, Plate, and Flat Bar; 2023.
- D. ASTM A743/A743M - Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application; 2021.
- E. ASTM B86 - Standard Specification for Zinc and Zinc-Aluminum (ZA) Alloy Foundry and Die Castings; 2023.
- F. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- G. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
- H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- I. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.
- J. NEMA LD 3 - High-Pressure Decorative Laminates; 2005

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate work with placement of support framing and anchors in walls and ceilings.

1.5 SUBMITTALS

- A. Product Data: Provide data on [panel construction, hardware, accessories, finishes.
- B. Shop Drawings:
 - 1. Indicate plans, elevations, dimensions. Include door swings, toilet fixture centerlines, floor drains on plans.
 - 2. Indicate details of wall and ceiling supports and attachments.
 - 3. Indicate reflected ceiling plan view of and ceiling-mounted items at overhead support locations.
 - 4. Indicate cutouts for through-partition toilet accessories.
- C. Samples:
 - 1. For Initial Selection: Submit samples for each type of toilet compartment material.
 - 2. For Verification: Submit two samples of partition materials, 3 by 3 inches (76 by 76 mm) in size, indicating color.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with at least three years of documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, handle materials and products in accordance with manufacturer's instructions, recommendations, and industry standards.
- B. Do not deliver materials or begin installation until building enclosed, with complete protection from outside weather, and maintain building temperature at minimum of 60 degrees F (15.6 degrees C).
- C. Store products indoors in manufacturer's or fabricator's original containers and packaging, with labels clearly identifying product name and manufacturer. Protect from damage.
- D. Lay cartons flat, with adequate support to ensure flatness and prevent damage to prefinished surfaces.
- E. Do not store where ambient temperature exceeds 120 degrees F (49 degrees C).

1.8 FIELD CONDITIONS

- A. Ambient Conditions: Maintain environmental conditions such as temperature, humidity, and ventilation within limits recommended by manufacturers for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.
- B. Ambient Conditions: Maintain building temperature at a minimum of 60 degrees F (15.6 degrees C) for 24 hours before, during, and after installation of toilet partitions.
- C. Existing Conditions: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.

1.9 WARRANTY

- A. Black Core or Color-Thru Phenolic Finish Warranty: Provide 25-year manufacturer warranty against delamination, breakage or corrosion of black core or color-thru phenolic material properly maintained in accordance with manufacturer's recommendations.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- a. Basis of Design Manufacturer: ASI Global Partitions: www.asi-globalpartitions.com/#sle.
- b. Substitutions: See Section 016000 - Substitution Procedures.

2.2 PHENOLIC TOILET COMPARTMENTS

- a. Toilet Compartments: Black core phenolic.
 - 1) Standard-58; ceiling hung mounting.
- b. Urinal Screens: Black core phenolic, wall hung.
- c. Design Criteria:
 - 1) Accessibility: Design compartments indicated on drawings to comply with ICC A117.1 and ADA Standards.
 - 2) Black Core Phenolic Surface Burning Characteristics: Provide assemblies with flame spread index of 75 or less and smoke developed index of 450 or less, Class B, when tested in accordance with ASTM E84.
- d. Fabrication:
 - 1) Fabricate toilet compartment components to sizes indicated.
 - 2) Coordinate requirements and provide cutouts for through-partition toilet accessories and solid blocking within panel where required for attachment of toilet accessories.

- 3) Provide shoes and caps at pilasters and posts to conceal anchorage, supports, and leveling mechanisms.
- 4) Provide manufacturer's standard corrosion-resistant supports, leveling mechanisms, anchors, and anchoring assemblies for pilasters and posts.
- 5) Ceiling Hung Units: Provide anchoring assemblies with leveling adjustment nuts at pilasters for connection to structural steel support with two adjustable hanging studs above finished ceiling. Provide assemblies that support pilasters from structural steel without transmitting load to finished ceiling.
- 6) Urinal and Entrance Screen Posts: Provide anchoring assemblies with leveling adjustment at bottoms of posts.

2.3 COMPONENTS

- a. Doors, Panels, and Pilasters: Phenolic-resin impregnated, wood-based product core with melamine-impregnated decorative surface papers and transparent, protective topcoat; NEMA LD 3 Compact Laminate.
 - 1) Finish: Matte.
 - 2) Black Core Phenolic Color: As indicated in drawings
 - 3) Privacy: Provide interlocking doors and pilasters with integral Zero-Sightline System routed edges.
- b. Standard Door and Panel Dimensions:
 - 1) Door Thickness: 3/4 inch (19 mm).
 - 2) Door Width: 24 inches (610 mm).
 - 3) Door Width for Handicapped Use: 36 inches (915 mm).
 - 4) Standard-58:
 - i. Door Panel Height: 58 inches (1473 mm).
 - ii. Door Height above Floor: 12 inches (305 mm).
 - 5) Panel Thickness: 1/2 inch (13 mm).
 - 6) Urinal Panel Height: 48 inches (1219 mm).
 - 7) Urinal Panel Height above Floor: 12 inches (305 mm).
- c. Standard Pilasters: 3/4 inch (19 mm) thick, of sizes required to suit compartment width and spacing.
 - 1) Pilaster Shoes: Formed 20 gauge, 0.0359 inch (0.91 mm) ASTM A666 Type 304 stainless steel with No.4 finish, [4 inches (102 mm)] [5 inches (127 mm)] [[_____] inches ([_____] mm)] high, concealing ceiling fastenings; secured to pilaster with stainless steel tamper-resistant screws; secured to floor with concrete anchors.
 - 2) Pilaster Anchors: Manufacturer's standard mounting bars attached to pilaster and secured to building structure.
- d. Urinal Post: Manufacturer's standard post design of material matching thickness and construction of pilasters with shoe matching pilaster shoe.

2.4 MATERIALS

- a. Aluminum Extrusions: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper.
- b. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304, stretcher-leveled standard of flatness.
- c. Stainless Steel Castings: ASTM A743/A743M.
- d. Zamac: ASTM B86, commercial zinc-alloy die castings, chrome plated.

- e. Phenolic Panels: Monolithic core of phenolic resin, reinforced with cellulose fibers, manufactured under high pressure and at high temperatures, with melamine-impregnated decorative surface papers; NEMA LD 3, Compact Laminate.

2.5 HARDWARE AND ACCESSORIES

- a. Brackets:
 - 1) Continuous Type: Brushed stainless steel, standard depth.
- b. Standard Door Hardware: Brushed stainless steel:
 - 1) Hinges: Brushed stainless steel vault hinges, gravity type, adjustable for door close positioning; two per door.
 - 2) Latch and Keeper: Brushed stainless steel surface mount slide
 - 3) Coat Hook: Manufacturer's standard coat hook with rubber bumper; one per compartment, mounted on door.
 - 4) Door Pull: Provide door pull for outswinging doors. Provide on both sides of doors designated as accessible.
 - 5) Door Bumper: Provide rubber-tipped door bumpers at out-swinging doors.
- c. Attachments, Screws, and Bolts: Stainless steel, tamper-resistant type.
 - 1) For Attaching Panels and Pilasters to Brackets: Sex-type through-bolts and nuts, tamper-resistant.
- d. Toilet Partition Suspension Members: See Section 055000 .

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that field measurements are as indicated on shop drawings.
- C. Verify correct spacing of and between plumbing fixtures.
- D. Verify correct location of built-in framing, anchorage, and bracing.

3.2 INSTALLATION

- A. Install partitions secure, rigid, plumb, and level in accordance with manufacturer's written instructions.
- B. Attach panel brackets securely to walls using anchor devices.
- C. Attach panels and pilasters to brackets. Locate head rail joints at pilaster centerlines.
- D. Field touch-up of scratches or damaged finish not permitted. Replace damaged or scratched materials with new materials.

3.3 TOLERANCES

- A. Maximum Variation from True Position: 1/4 inch (6 mm).
- B. Maximum Variation from Plumb: 1/8 inch (3 mm).

3.4 ADJUSTING

- A. Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding 3/16 inch (5 mm).
- B. Adjust hinges to locate doors in partially opened position when unlatched. Return outswinging doors to closed condition.
- C. Adjust adjacent components for consistency of line or plane.

NEW CONSTRUCTION FOR:
DOW GARDENS WELCOME CENTER
MIDLAND, MICHIGAN

PROJECT NO. 2022022

3.5 CLEANING

- A. Clean partition and screen surfaces with materials and cleansers in accordance with manufacturer's recommendations.

END OF SECTION

SECTION 10 22 26 - Operable Partitions

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Manually operated, paired panel operable partitions
- B. Related Sections include the following:
 - 1. Division 03 Sections for concrete tolerances required.
 - 2. Division 05 Sections for primary structural support, including pre-punching of support members by structural steel supplier per operable partition supplier's template.
 - 3. Division 06 Sections for wood framing and supports, and all blocking at head and jambs as required.
 - 4. Division 09 Sections for wall and ceiling framing at head and jambs.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is certified in writing by the operable partition manufacturer, as qualified to install the manufacturer's partition systems for work similar in material design, and extent to that indicated for this Project.
- B. Acoustical Performance: Test operable partitions in an independent acoustical laboratory in accordance with ASTM E90 test procedure and classified in accordance with ASTM E413 to attain no less than the STC rating specified. Provide a complete and unedited written test report upon request.
- C. Preparation of the opening shall conform to the criteria set forth per ASTM E557 Standard Practice for Architectural Application and Installation of Operable Partitions.
- D. The operable wall must be manufactured by a certified ISO-9001-2015 company or an equivalent quality control system.

1.4 REFERENCE STANDARDS

- A. ASTM International
 - 1. ASTM E557 Standard Practice for Architectural Application and Installation of Operable Partitions.
 - 2. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
 - 3. ASTM C1036 - Standard Specification for Flat Glass.
 - 4. ASTM C1048 - Heat Treated Flat Glass - Kind HS, Kind FT Coated and Uncoated Glass.
 - 5. ASTM E84 - Surface Burning Characteristics of Building Materials
 - 6. ASTM E413 - Classification for Rating Sound Insulation
- B. Health Product Declaration Collaborative
 - 1. Health Product Declaration Open Standard v2.1
- C. International Standards Organization
 - 1. ISO 14021 - Environmental Labels and Declarations - Self-Declared

Environmental Claims (Type II Environmental Labeling).

2. ISO 14025:2011-10, Environmental Labels and Declarations – Type III Environmental Declarations – Principles and Procedures
3. ISO 14040 :2009-11 Environmental Management
– Life Cycle Assessment – Principles and Framework.
4. ISO 14044 :2006-10, Environmental Management
– Life Cycle Assessment – Requirements and Guidelines.
5. ISO 21930 – Sustainability in Buildings and Civil Engineering Works – Core Rules for Environmental Product Declarations of Construction Projects and Services.

D. Other Standards

1. ADA – American Disabilities Act.
2. ANSI Z97.1 – Safety Glazing Materials Used in Buildings.
3. CPSC 16 CFR 1201 – Safety Standard for Architectural Glazing Materials.
4. NEMA LD3 – High Pressure Decorative Laminates

1.5 SUBMITTALS

- A. Product Data: Material descriptions, construction details, finishes, installation details, and operating instructions for each type of operable partition, component, and accessory specified.
- B. Shop Drawings: Show location and extent of operable partitions. Include plans, elevations, sections, details, attachments to other construction, and accessories. Indicate dimensions, weights, conditions at openings, and at storage areas, and required installation, storage, and operating clearings. Indicate location and installation requirements for hardware and track, including floor tolerances required and direction of travel. Indicate blocking to be provided by others.
- C. Setting Drawings: Show imbedded items and cutouts required in other work, including support beam punching template.
- D. Samples: Color samples demonstrating full range of finishes available by architect. Verification samples will be available in same thickness and material indicated for the work.
- E. Reports: Provide a complete and unedited written sound test report indicating thickness and spacing in test specimen matches product as submitted.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Clearly mark packages and panels with numbering systems used on Shop Drawings. Do not use permanent markings on panels.
- B. Protect panel and glazing materials during delivery, storage, and handling to comply with manufacturer's direction and as required to prevent damage.

1.7 WARRANTY

- A. Provide written warranty by manufacturer of operable partitions agreeing to repair or replace any components with manufacturing defects.
- B. Warranty period: Two (2) years

PART 2 – PRODUCTS

2.1 MANUFACTURERS, PRODUCTS, AND OPERATION

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 1. Modernfold, Inc.

- B. Products: Subject to compliance with requirements, provide the following product:
 - 1. Acousti-Seal® Legacy® - Paired Panel (932) manually operated paired panel operable partition

2.2 OPERATION

- A. Acousti-Seal® Legacy® - Paired Panel (932): Series of paired flat panels hinged together in pairs, manually operated, top supported with operable floor seals.
- B. Final Closure:
 - 1. Hinged panel closure

2.3 PANEL CONSTRUCTION

- A. Nominal 3-inch (76mm) thick panels in manufacturer's standard 48-inch (1220mm) widths. All panel horizontal and vertical framing members fabricated from minimum 16-gage formed steel with overlapped and welded corners for rigidity. Top channel is reinforced to support suspension system components. Frame is designed so that full vertical edges of panels are of formed steel and provide concealed protection of the edges of the panel skin.
- B. Panel Skin Options:
 - 1. Roll-formed 21-gage steel wrapping around panel edge. Panel skins shall be lock formed and welded directly to the frame for unitized construction. Acoustical ratings of panels with this construction (Select One):
 - a. 52 STC
 - 2. Roll-formed 21-gage Micro-Perf™ steel wrapping around panel edge provided on 50% of panel faces manufactured with sound absorptive backing. Panel skins shall be lock formed and welded directly to the frame for unitized construction. Acoustical ratings of panels with this construction shall be no less than:
 - a. 45 STC (net with NRC construction)
 - b. 0.65 NRC with wall covering and upholstery fabric or non-woven needle punch carpet covering
- C. Hinges for Closure Panels, Pass Doors, and Pocket Doors shall be:
 - 1. Full leaf butt hinges, attached directly to panel frame with welded hinge anchor plates within panel to further support hinge mounting to frame. Lifetime warranty on hinges. Hinges mounted into panel edge or vertical astragal are not acceptable.
 - 2. SOSS® Invisible laminated hinge with antifriction segments mounted between each heat-treated link. Hinge to be attached directly to panel frame. Welded internal hinge bracket shall support the hinge and allow for adjustment of hinge plates. Concealed hinges mounted into edge or vertical astragal are not acceptable (available on steel skin panel only)
- D. Panel Trim: No vertical trim required or allowed on edges of panels; minimal groove appearance at panel joints.
- E. Panel Weights:
 - 1. 52 STC - 11 lbs./square foot

2.4 PANEL FINISHES

- A. Panel face finish shall be:
 - 1. Xorel Fabric
 - 2. Color: As indicated in drawings.
- B. Panel Trim: Exposed panel trim of one consistent color from manufacturer's standard offering.

1. Dark Bronze
2. Smoke Gray
3. Natural Choice
4. Black

2.5 SOUND SEALS

- A. Vertical Interlocking Sound Seals between panels: Roll- formed steel astragals, with reversible tongue and groove configuration in each panel edge for universal panel operation. Rigid plastic or aluminum astragals or astragals in only one panel edge are not acceptable
- B. Horizontal Top Seals: Continuous contact extruded vinyl bulb shape with pairs of non-contacting vinyl fingers to prevent distortion without the need for mechanically operated parts
- C. Horizontal Bottom Seals (Select One):
 1. Modernfold IA2 Bottom Seal. Automatic operable seals providing nominal 2-inch (51 mm) operating clearance with an operating range of +1/2-inch (13 mm) to -1-1/2-inch (38 mm) which automatically drop as panels are positioned, without the need for tools or cranks.
120 pounds (54 kg) downward force to the floor throughout operating range.

2.6 SUSPENSION SYSTEM (Select One):

- A. #14 Suspension System
 1. Suspension Tracks: Minimum 7-gage, 0.18- inch(5mm) roll formed steel. Track shall be supported by adjustable steel hanger brackets connected to structural support of pairs of ½-inch (13mm) diameter threaded rods. Brackets must support the load bearing surface of the track.
 - a. Exposed track soffit: Steel, removable for service and maintenance, attached to track bracket without exposed fasteners, and pre-painted off-white
 2. Carriers: One all steel trolley with steel-tired ball bearing wheels per panel (except hinged panels). Non-steel tires are not acceptable.
 3. Warranty period: Twenty (20) years.
- B. Available Accessories/Options:
 1. Pocket Doors: Acousti-Seal® Pocket Doors by Modernfold, Inc., with same construction, finish, and appearance as the adjacent panels.
 2. Finished end caps
 3. Intersecting partition interface.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Comply with ASTM E557, operable partition manufacturer's written installation instructions, drawings, and approved Shop Drawings.
- B. Install operable partitions and accessories after other finish operations, including painting have been completed
- C. Match operable partitions by installing panels from marked packages in numbered sequence indicated on Shop Drawings.
- D. Broken, cracked, chipped, deformed, or unmatched panels are not acceptable.

3.2 CLEANING AND PROTECTION

- A. Clean partition surfaces upon completing installation of operable partitions to remove dust, dirt, adhesives, and other foreign materials according to manufacturer's written instructions.
- B. Provide final protection and maintain conditions in a manner acceptable to the manufacturer and installer that ensure operable partitions are without damage or deterioration at time of Substantial Completion.

3.3 ADJUSTING

- A. Adjust operable partitions to operate smoothly, easily, and quietly, free from binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruptions, or malfunction, throughout the entire operation range. Lubricate hardware and other moving parts.

3.4 EXAMINATION

- A. Examine flooring, structural support, and opening, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of operable partitions. Proceed with installation only after unsatisfactory conditions have been corrected.

3.5 DEMONSTRATION

- A. Demonstrate proper operation and maintenance procedures to Owner's representative.
- B. Provide Operation and Maintenance Manual to Owner's representative.

END OF SECTION 102226

SECTION 102600 - WALL PROTECTION

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. Wall protections.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Verifications: For each type of product indicated, in manufacturer's standard-size Samples, but not less than 12 inches (300 mm) long, of each resilient product required.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
- B. Product Options: Drawings indicate size, profiles, and dimensional requirements of impact-resistant wall-protection units and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
 - 1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
- C. Fire-Test-Response Characteristics: Provide impact-resistant, plastic wall-protection units with surface-burning characteristics as determined by testing identical products per ASTM E 84, NFPA 255, or UL 723 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
- D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store impact-resistant wall-protection units in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

1.6 PROJECT CONDITIONS

- A. Maintain temperatures within range recommended by manufacturer, but not less than 65° F (21° C) or more than 75° F (35° C), in spaces to receive resilient base during the following time periods:
 - 1. 24 hours before installation.
 - 2. During installation.
 - 3. 24 hours after installation.
- B. After post installation period, maintain temperature range within range recommended by manufacturer, but not less than 55° F (13° C) or more than 95° F (35° C).

- C. Install resilient products after other finishing operations, including painting, have been completed.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Furnish not less than 10 linear feet (3 linear m) for every 500 linear feet (150 linear m) or fraction thereof, of each type, color, patter, and size of resilient product installed.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of impact-resistant wall-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.
 - b. Deterioration of plastic and other materials beyond normal use.
 - 2. Warranty Period: One years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CORNER GUARDS (CG-1) (As indicated in drawings in Kitchen 124,128)

- A. Surface mount Stainless Steel
- B. 16 Ga, Type 304 S/S
- C. #4 Finish
- D. Size: 2" x 2"
- E. Lengths: 8' Height
- F. Angular shape: 90°

2.2 FABRICATION

- A. Fabricate components with tight seams and joints 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.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances, fire rating, and other conditions affecting performance of work.
- B. Complete finishing operations, including painting, before installing impact-resistant wall-protection system components.
- C. Before installation, clean substrate to remove dust, debris, and loose particles.
- D. General: Install impact-resistant wall-protection units 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.

3.2 CLEANING AND PROTECTION

- A. Perform the following operations immediately after completing resilient product installation:

1. Remove adhesive and other blemishes from exposed surfaces.
 2. Sweep and vacuum surface thoroughly.
 3. Damp-mop surfaces to remove marks and soil.
 - a. Do not wash surfaces until after time period recommended by manufacturer.
- B. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.

END OF SECTION 102600

SECTION 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Public-use washroom accessories.
 - 2. Custodial Accessories

1.2 ACTION SUBMITTALS

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

1.3 INFORMATIONAL SUBMITTALS

- A. Sample warranties.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.5 WARRANTY

- A. Manufacturer's Special Warranty for Mirrors: Manufacturer agrees to repair or replace mirrors that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Design accessories and fasteners to comply with the following requirements:
 - 1. Grab Bars: Installed units are able to resist 250 lbf concentrated load applied in any direction and at any point.

2.2 MANUFACTURERS

- A. Basis-of-Design Products: The design for toilet and bath accessories described in Part 2 are based on products as manufactured by American Specialties, Inc. Subject to compliance with requirements, provide the named product or comparable product by one of the following:
 - 1. Toilet and Bath Accessories:
 - a. A & J Washroom Accessories, Inc.
 - b. Bobrick Washroom Equipment, Inc.
 - c. Bradley Corporation.
 - d. General Accessory Manufacturing Co. (GAMCO).

- e. Tubular Specialties Manufacturing, Inc
- f. Substitutions: See Section 012500 - Substitution Procedures.

2.3 MATERIALS

- A. Stainless Steel: ASTM A 666, Type 304, No. 4 finish (satin), 0.0312-inch (0.8-mm) minimum nominal thickness, unless otherwise indicated.
- B. Steel Sheet: ASTM A 366/A 366M, 0.0359-inch (0.9-mm) minimum nominal thickness.
- C. Galvanized Steel Sheet: ASTM A 653/A 653M, G60 (Z180).
- D. Chromium Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).
- E. Baked-Enamel Finish: Factory-applied, gloss-white, baked-acrylic-enamel coating.
- F. Galvanized Steel Mounting Devices: ASTM A 153/A 153M, ho-dip galvanized after fabrication.
- G. Fasteners: Screws, bolts, and other devices of same material as accessory unit, tamper and theft resistant when exposed, and of galvanized steel when concealed.
- H. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

2.4 PUBLIC-USE WASHROOM ACCESSORIES

- A. Toilet Tissue (Roll) Dispenser.
 - 1. Owner furnished and Contractor installed.
- B. Paper Towel (Roll) Dispenser
 - 1. Owner furnished and Contractor installed.
- C. Liquid Soap Dispenser (at wall mounted lavatories):
 - 1. Owner furnished and Contractor installed.
- D. Grab Bar:
 - 1. Basis-of-Design: American Specialties, Inc., 3800 series, straight grab bar.
 - 2. Mounting: Flanges with concealed fasteners.
 - 3. Material: Stainless steel, 0.05 inch (1.3 mm) thick.
 - a. Finish: Smooth, No. 4 finish (satin) on ends and slip-resistant texture in grip area.
 - 4. Outside Diameter: 1-1/2 inches (38 mm).
 - 5. Configuration and Length: As indicated on Drawings.
- E. Sanitary-Napkin Disposal Unit:
 - 1. Owner furnished and Contractor installed.
- F. Mirrors
 - 1. See Electrical Specification for illuminated mirrors.
- G. Utility Hook
 - 1. Basis-of-design: Richelieu Utility Stainless Steel Hook
 - 2. Sized to hold lift handles from ceiling hoist in Changing Place toilet.
 - 3. Contractor supplied and installed.
- H. Clothing Hook.
 - 1. Basis of Design Products: Bradley (9B1 Series) Elvari Single (00) Coat/Robe Hook
 - a. 14 gauge, 300 series stainless steel in a brushed #3 satin finish.
 - b. Fasteners, set screws, and hex key included.

- c. Overall dimensions- Single Hook: 2-3/4"H x 1-3/16W x 1-11/16D
 - d. No visible welds or mounting hardware.
 - e. Surface Mounted.
 - f. Refer to Standard Mounting Heights and elevations for installation.
2. Substitutions: The Architect will consider products of comparable manufacturers as a substitution, pending the contractor's submission of adequate documentation of the substitution in accordance with procedures in Division 1 of the Project Manual. See Section 012500 - Substitution Procedures.

2.5 CUSTODIAL ACCESSORIES

- A. Mop and Broom Holder With Utility Shelf:
1. Basis-of-Design Product: Bobrick; B-224 x 36 .
 2. Description: Unit with shelf, hooks, holders, and rod suspended beneath shelf.
 3. Length: 36 inches (914 mm)
 4. Hooks: Three.
 5. Mop/Broom Holders: Four, spring-loaded, rubber hat, cam type.
 6. Material and Finish: Stainless steel, No. 4 finish (satin).
 - a. Shelf: Not less than nominal 0.05-inch- (1.3-mm-) thick stainless steel.
 - b. Rod: Approximately 1/4-inch- (6-mm-) diameter stainless steel.
- B. Mop and Broom Holder
1. Basis-of-Design Product: Bobrick; B223-24
 2. Description: Surface mount Mop/Broom holder with 3 spring loaded rubber cam grips
 3. Length: 24"
 4. Material and Finish: Stainless Steel, No. 4 finish (satin)

2.6 FABRICATION

- A. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

2.7 FABRICATION

- A. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
1. Remove temporary labels and protective coatings.
- B. Grab Bars: Install to comply with specified structural-performance requirements.

NEW CONSTRUCTION FOR:
DOW GARDENS WELCOME CENTER
MIDLAND, MICHIGAN

PROJECT NO. 2022022

END OF SECTION 102800

SECTION 104011 - SLATWALL

PART 1 GENERAL

1.1 SUMMARY:

- A. Slotted wood paneling for display or wall perimeter applications.

1.2 REFERENCES

- A. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 1997a.

1.3 SUBMITTALS

- A. Product Data: Manufacturer's product information to include physical characteristics and limitations of components, maintenance and cleaning recommendation.
- B. Shop Drawings: Fabrication/ Installation drawings to include elevations, joint details, fastening methods, backing requirements, panel jointing system and other features.
- C. Samples: Custom laminate (PLAM-1) as indicated on drawings.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. This section is based on the products from Slatwall Systems, www.slatwallsystems.com. 3645 N 40th Avenue, Phoenix, AZ 85019. Tel: 888/ 454-1233 or 602/ 272-5266. Fax: 602/ 233-1014
- B. Requests for substitutions will be considered in accordance with provisions of Section xxxxx.

2.2 MATERIALS

A. PANELING:

3/4 inch (19 mm) thick medium density fiberboard grooved to receive 3" standard-sized fixture mounting brackets for display. MDF paneling to be consistent with the following:

Formaldehyde Emission: Less than 0.3 ppm.

Density: 46-48 pounds per cubic foot (737 kg/cu m) average.

Flame Spread: 200, maximum, when tested in accordance with

ASTM E 84-94 (Class C, Class III).

Inner Bond Strength: 100 psi to 105 psi average.

Modulus of Rupture: 3500-4000 psi

Modulus of Elasticity: 350,000-400,000 psi

Linear Expansion: 0.24-0.30 percent.

Screw Holding Strength at Edge: 250-275 pounds

Screw Holding Strength at Face: 300 pounds

Moisture Content: 4 to 8 percent.

Thickness Tolerance: plus/minus 0.005 inch (0.13 mm).

Length and Width Tolerance: Plus/Minus 0.0625 inch (1.59 mm).

Squareness Tolerance: 0.0156 inch per linear foot (0.13 mm in 1 m).

B. SLATWALL TYPE:

Slats: T-shaped, spaced at 3 inches (75 mm) on center. Slat

Direction: Oriented to short dimension of panel. (8x4)

C. FINISH:

High pressure plastic laminate, custom laminate.

High pressure plastic laminate:

(PLAM-1) Arborite Copper Artisian Walnut W2003AW

D. GROOVE FINISH:

Extruded aluminum T-shaped insert mill finish

A. PANEL SPECIFICS:

Panel Size: As indicated in drawings.

E. ACCESSORIES:

A. Faceout brackets:

- a. Basis of Design: Uline Straight Faceout S-18610BL
- b. Color: Black
- c. Depth: 12"
- d. Coordinate with HPL boxed floating shelves as indicated in drawings.

3.1 EXAMINATION

- A. Verify that supports are installed correctly before beginning installation of panels.

3.2 PREPARATION

- A. Store panels laid flat in the area in which they are to be installed for at least 48 hours prior to installation, to acclimate to ambient conditions.

3.3 INSTALLATION

- A. Install panels using adhesive and screws, in accordance with panel manufacturer's/ fabricators instructions.
- B. Use a bead of adhesive the full width of the panel at each stud location.
- C. Locate panel ends over studs.
- D. Screw panels to every other stud and not more than 12 inches on center vertically; install screws in grooves. Flathead, 1-1/2 inches (38 mm) long, minimum
- F. If panels must be cut to shorten, cut from bottom of lowest panel on wall.

END OF SECTION 101140

SECTION 104413 - FIRE PROTECTION CABINETS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes fire-protection cabinets for portable fire extinguishers.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For fire-protection cabinets.

1.3 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.4 COORDINATION

- A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.
- B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements in ASTM E 814 for fire-resistance rating of walls where they are installed.

2.2 FIRE-PROTECTION CABINET

- A. Cabinet Type: Suitable for fire extinguisher.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. J.L. Industries, Inc., a division of Activar Construction Products Group.
 - b. Kidde Residential and Commercial Division, Subsidiary of Kidde plc.
 - c. Larsen's Manufacturing Company.
 - d. Modern Metal Products, Division of Technico Inc.
 - e. Potter Roemer LLC.
 - f. Substitutions: See Section 01 6000 - Substitution Procedures.
- B. Cabinet Construction: Nonrated.
- C. Cabinet Material: Cold-rolled steel sheet.
- D. Recessed Cabinet:
 - 1. Exposed Flat Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).
- E. Semi-Recessed Cabinet (used only where wall depth does not allow a fully recessed cabinet.)
 - 1. Exposed Flat Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).
 - a. Rolled-Edge Trim: 2-1/2 inch backbend depth.
- F. Cabinet Trim Material: Steel sheet.

- G. Door Material: Steel sheet.
- H. Door Style: Fully glazed panel with frame.
- I. Door Glazing: Tempered float glass (clear).
- J. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
- K. Materials:
 - 1. Cold-Rolled Steel: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.
 - a. Finish: Stainless Steel
 - b. Color: As selected by Architect from full range of industry colors and color densities.
 - 2. Tempered Float Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).

2.3 ACCESSORIES

- A. Mounting Brackets: Manufacturer's standard steel, designed to secure extinguisher, of sizes required for types and capacities of extinguishers indicated, with plated or backed-enamel finish.
- B. Identification: Provide lettering to comply with authorities having jurisdiction for letter style, color, size, spacing, and location. Locate as indicated by Architects.
 - 1. Identify fire extinguisher in cabinet with the words "FIRE EXTINGUISHER" applied to door.
 - a. Application Process: Vinyl letters.
 - b. Lettering Color: Red.
 - c. Orientation: Horizontal.

2.4 FABRICATION

- A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Prepare recesses for recessed fire-protection cabinets as required by type and size of cabinet and trim style.
- B. Install fire-protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.
- C. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.
- D. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

END OF SECTION 104413

SECTION 104416 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

1.2 ACTION SUBMITTALS

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

1.3 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.4 COORDINATION

- A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

1.5 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
- B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

- A. Fire Extinguishers: Type, size, and capacity for each fire-protection cabinet and mounting bracket indicated.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amerex Corporation.
 - b. Ansul Incorporated; Tyco International Ltd.
 - c. Badger Fire Protection; a Kidde company.
 - d. J.L. Industries, Inc.; a division of Activar Construction Products Group.
 - e. Kidde Residential and Commercial Division; Subsidiary of Kidde plc.
 - f. Larsen's Manufacturing Company.
 - g. Potter Roemer LLC.
 - h. Pyro-Chem; Tyco Safety Products.
 - i. Substitutions: See Section 012500 - Substitution Procedures.

2. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B.
- B. Multipurpose Dry-Chemical Type MP: UL-rated 4-A:60-B:C, 10-lb (4.5 kg) nominal capacity, with monoammonium phosphate-based dry chemical in manufacturer's standard enameled container.
- C. Wet-Chemical Type K: UL-rated K; 1.6-gallon nominal capacity, with potassium-acetate based chemical in manufacturer's standard enameled container.

2.3 MOUNTING BRACKETS

- A. Mounting Brackets: Manufacturer's standard galvanized steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated black baked-enamel finish.
- B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location.
 1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.
 - a. Orientation: Horizontal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Examine fire extinguishers for proper charging and tagging.
 1. Remove and replace damaged, defective, or undercharged fire extinguishers.
- B. Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.
 1. Mounting Brackets: 54 inches (1372 mm) above finished floor to top of fire extinguisher.
- C. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION 104416

SECTION 11 4000 - KITCHEN EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The general provisions of the Contract, including instructions to bidders, General Conditions, Supplementary Conditions, General Requirements, apply to the work specified in this section.

1.2 DESCRIPTION

- A. The fabrication requirements attached are a governing part of this specification and shall be consulted for all matters pertaining to the work. When references are made to FSEC, the same shall be construed to designate the Food Service Equipment Contractor.
- B. The FSEC is to provide all items, articles, materials, transportation, operations, and methods listed, mentioned, or scheduled on the drawings and specifications, including all labor, materials, equipment, and incidentals necessary and as required for their completion.

1.3 QUALITY ASSURANCE

A. Brands and Names

- 1. The manufacturer's catalog designations used in the following specifications are intended to illustrate and represent the standards which will be required by the Owner. Bidders are to list, by item number, manufacturer's name and quantities on itemized proposal form attached to the specifications for approval by the Owner. When not attached, the FSEC shall make up his own itemized list and submit same attached with his bid. NOTE! Base Bid must be on fixtures specified for fair comparison of all bids.

B. Substitutions

- 1. Substitutions by any bidder wishing to supply alternate equipment other than that specified may submit a separate itemized proposal on similar articles of other manufacturers of the same standard performance, capacity, size, durability and appearance but must accompany their alternate proposal with complete descriptive literature of the item quoted.
- 2. Owner and Architect reserve the right to accept or reject such proposed substitutions. Bidders recommending such substitutions are cautioned to examine the mechanical plans that may have already been approved and conditions at the building site to determine if such substitutions require changes in mechanical connections already planned or installed.
- 3. If the proposed substitutions require such changes, the Bidder shall include the cost of same in his bid and call it to the attention of the Architect and Owner by including a descriptive notation in his bid.

C. Discrepancies

1. Where model numbers, quantities, sizes or gauges of material differ on plans and specifications, it shall be understood that the FSEC shall figure the larger quantities, longest size and heavier gauge unless advised otherwise in writing.
2. Where an accessory or piece of equipment is shown on elevation or plan, it shall be deemed part of the Food Service Contract, even if it is not listed in the Item Specifications.
3. Where an item is listed in Item Specifications and not shown on plan or elevations, the item shall be deemed part of the Food Service Equipment Contract.

D. Measurements

1. All dimensions given on bidding documents are approximate and are as accurate as can be determined at the time. The Equipment Contractor shall check all measurements at the building prior to fabrication of equipment and shall bring any deviation from the dimensions shown or required by building conditions to the Consultant's attention. All equipment must conform to the finished building conditions. Where obstructions occur, equipment must be neatly scribed fitting to and around same resulting in a sanitary fixture.
2. Prior to fabrication, the Consultant or the Owner reserves the right to require the Contractor to make reasonable modifications in the routing of the work and relocation of the equipment. This specifically refers to conditions where interference occurs or where materials cannot be installed because of structural or mechanical conditions encountered. The Contractor will receive no additional compensation for such work.

E. Ordinances

1. Work and materials shall be in full accord with the latest rules of U.S. Public Health Service, National Board of Fire Underwriters, O.S.H.A., local and state ordinances, State Accident Commissions Safety Ordinances, regulations of the Bureau of Fire Services and with prevailing ordinances.
2. Ordinances including building codes, gas codes, steam codes, and other codes applying to this contract shall be followed.
3. All applicable items shall conform to latest Standards Revisions established by the National Sanitation Foundations, (N.S.F.), Ann Arbor, Michigan.
4. Electric operated and/or heated equipment, fabricated or otherwise shall conform to the latest standards of National Electric Manufacturer's Association, Underwriters Laboratories, Inc., National Electric Code or local standards such as to be acceptable to authorities having jurisdiction.

5. Standard steam heated equipment shall be manufactured in accordance with A.S.M.E. code requirements and carry the A.S.M.E. stamp.
6. Burners for gas heated equipment shall be equipped with automatic lighters. Oven burners and other concealed burners shall have automatic safety pilots and conform to A.G.A. standards. All gas equipment is to be furnished with appliance pressure regulators.
7. The drawings and specifications shall govern whenever they require longer sizes or higher standards than are required by the ordinances.
8. The Ordinances shall govern whenever drawings and specifications require something which will violate the ordinances.
9. No extra change will be paid for furnishing items required by local and state ordinances not specified or shown on drawings. Rulings and interpretations of the enforcing agencies shall be considered as part of the ordinances.
10. Should any change in the drawings and specifications be required to conform to the above, the Architect shall be notified when bid is submitted.
11. After entering into contract, all necessary work shall be done to meet above laws, ordinances, Bureau of Fire Services requirements, etc., without additional expense to the Owner.

F. Samples

1. Samples of all hardware, locks, feet, brackets, and other materials that may be requested shall be submitted for approval before use.

G. Scheduling of Work

1. The work shall be scheduled so there will be no interference with work of other trades and so that it will cause no delay. A time schedule will be worked out for the entire building and this work shall keep pace with the set schedule, working nights, Sundays and holidays, if necessary, to complete the work within the time limit.

1.4 SUBMITTALS

- A. All submittals to be reviewed, stamped and dated by FSEC prior to sending them to the Contractor, Architect and Consultant. Submittals not bearing the FSEC's stamp will be rejected.
- B. FSEC shall submit required number of drawings, brochures and portfolios of all equipment, apparatus, materials, etc., which are applicable to this contract together with detailed specifications. Each piece of equipment, apparatus, and accessory to be checked by the FSEC to insure compliance with requirements of Architect's drawings and specifications and also brochures or any other item of information to be clearly marked for identification with respect to their application and installation locations. This specification page shall appear on every shop drawing.

- C. Approval and/or review of shop drawings, details, and equipment by the Consultant is for design and concept only and does not relieve the FSEC of responsibility for compliance with design drawings, details and specifications, verification of all dimensions of equipment and building conditions and reasonable adjustments due to deviations.
- D. While the Architect's drawings and specifications propose to be complete in all respects as to layout, type of equipment and materials, they are not intended to serve as detailed sleeve or insert drawings, and preparation of such drawings, required or necessary for this purpose, or to set equipment accurately, are to be the responsibility of the FSEC.
- E. FSEC shall submit drawings of all custom fabricated equipment within thirty (30) days after notification of contract award. Drawings to be accurately laid out and correlated with other contractors work and latest architectural final construction plans. Equipment elevation shop drawings must be on 3/4" scale (3/4" = 1'-0").
- F. Drawings to show detailed construction for each piece of equipment. Before submitting detail drawings for review, they must be checked by the FSEC with the specifications and shall show exactly how item will be fabricated. Construction of equipment shall not deviate from approved shop drawings without written approval from the Architect and/or Food Service Consultant.
- G. FSEC shall submit rough-in drawings for approval at a scale of 1/4" = 1'-0", locating accurately all utility connections for each item of equipment requiring the same. Rough-in plan to be drawn up using final architectural building drawings. NOTE! All rough-in connections to conform with normal acceptable standards. Rough-in requirements for present or future food service equipment shall be included on all drawings.
- H. FSEC 1/4" scale rough-in drawings are to be dimensioned from ends of finished walls. Shop drawings with dimensions from centerline of columns will not be accepted, unless approval has been given by Architect, Consultant or the General Contractor.
- I. Drawings showing all dimensions of bases or platforms and depressions to be submitted on a scale of 1/4" = 1'-0".
- J. Rough in connection notes are not to be listed under numbered rough in schedule, except for general purpose outlets or where drawing space is limited.
- K. Equipment rough in plans are to be furnished complete with layout plan and item schedule similar to food service consultants drawings. Plumbing, electrical, ventilation & depression plan, and base detail when required.
- L. Plumbing and electrical plans are to be on separate sheets when drawings are prepared at 1/4" scale. NOTE! Food Service Consultants documents are not to be traced.
- M. Manufacturers to strictly adhere to approved and reviewed drawings, except where field conditions require changes and in that event the Architect must be

notified in writing.

- N. Manufacturing of any equipment fitting between walls or between columns and walls to be withheld until actual field dimensions are set and approved by the General Contractor. All other items which do not require field dimensions are to be manufactured upon receipt of reviewed shop drawings.
- O. Upon completion of contract, the contractor is to deliver to the Owner two (2) complete sets of final working drawings and two (2) portfolios of purchased equipment bound in a binder.
- P. A time schedule will be worked out for the entire building and this work shall keep pace with set schedule, working nights, Sundays, and holidays, if necessary, to complete the work within the time limit.

1.5 JOB CONDITIONS

A. Job Meetings

- 1. It shall be the responsibility of the FSEC to have a qualified representative at all monthly or special job meetings to help the Architect and other contractors on the job to correlate work or answer questions so that the job can progress without any obstructions.

B. Examination of Premises

- 1. FSEC to check the Architectural Contract Plans and visit the premises at a suitable time to determine maximum size of equipment he can safely get into the building in one piece. Field joints to be held to a minimum. Should door openings not be large enough, FSEC shall provide field joints in equipment as required and re-weld inside of building.

C. Utilities Services

- 1. Rough-in cold water, hot water, waste and vent piping, duct work and electrical wiring to be installed by Plumbing and Electrical Trades. Such items are to be brought away from surface of floors, walls and/or ceilings by these Trades and capped prior to installation of food service equipment.

1.6 GUARANTEE

- A. FSEC is to furnish one (1) year written guarantee for equipment starting from date of acceptance by the Owner or the Owner's duly authorized representative. Guarantee to be in accordance with Architect's General Conditions.
- B. Refrigeration - Self-contained
 - 1. All self-contained refrigeration compressors for milk coolers, ice cream cabinets, cold food counters, reach in refrigerators or freezers, etc., shall be furnished with a five (5) year compressor warranty and one (1) year refrigeration service starting from date of final acceptance.

PART 2 PRODUCTS

2.1 PRODUCTS

A. Fabrication Requirements – See following page for details

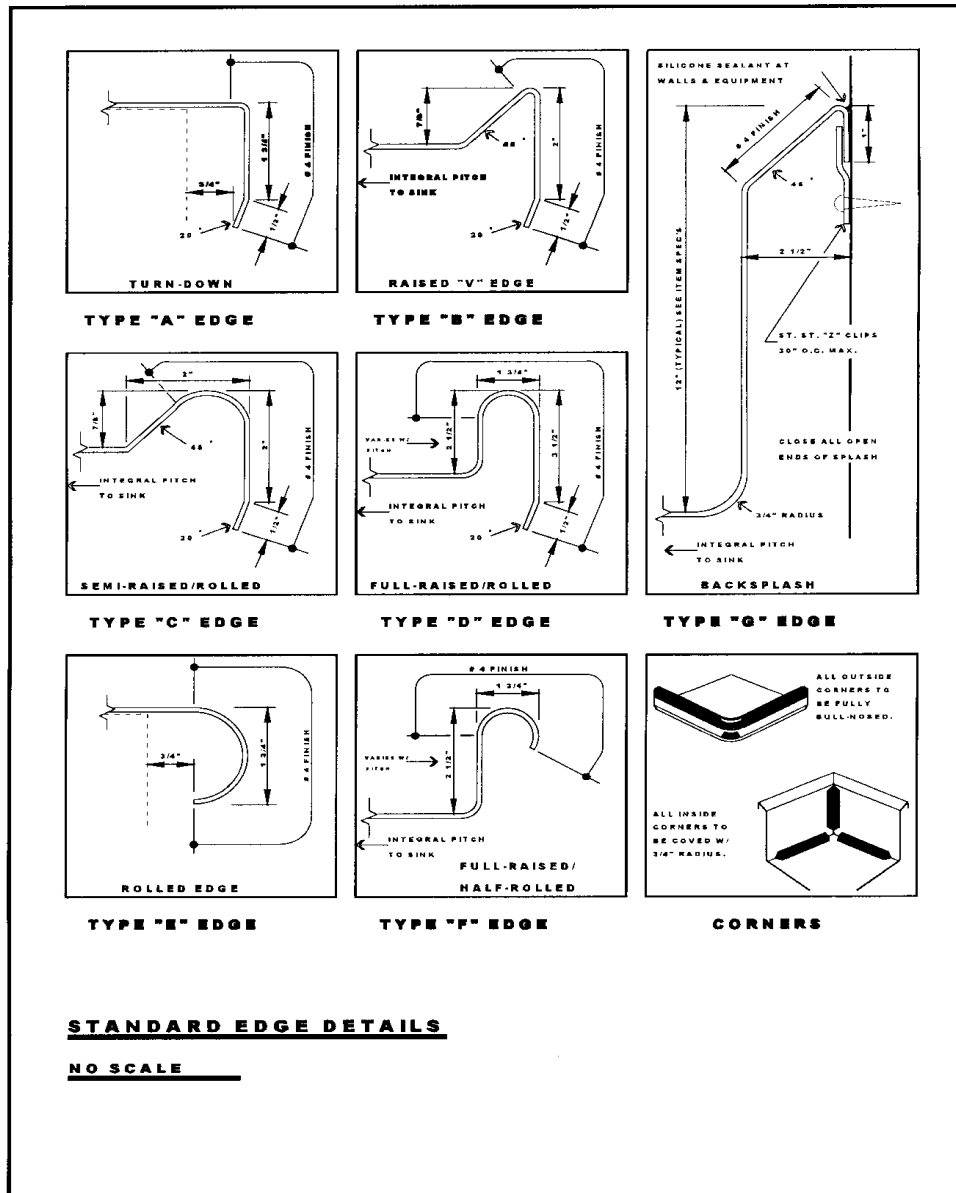
1. All food service equipment is to be constructed in strict compliance with the latest standards of the National Sanitation Foundation and to meet all requirements of the local and State Health Regulations. All equipment to bear the N.S.F. seal of approval.

B. Welding

1. The words "weld", "welded", or "welding" as used in the item specifications, mean a metal joint continuously welded then all exposed parts ground smooth and polished to match adjoining surfaces.
2. All welding to be done in a thorough manner with welding rod of same composition as sheets or parts welded. Welds to be strong, ductile with excess metal and discoloration ground off and joint finished smooth to match adjoining surfaces.
3. Welds to be free of imperfections such as pits, runs, splatters, cracks, warping or discoloration. All welded joints to be homogeneous with parent metal itself. All fabricated equipment items where metal to metal butt joints occur to be joined and properly welded then ground and polished smooth.

C. Grinding, Polishing and Finishing

1. All exposed welded joints to be ground flush with adjoining material and neatly finished to harmonies therewith.



1. Whenever material has been depressed or sunken in by welding operations, such depressions shall be suitably hammered and peened flush with adjoining surfaces to then be polished and/or buffed to match adjoining surfaces to a degree consistent with good workmanship. Care shall be exercised in all grinding operations to avoid excessive heating of metal and metal discoloration. Abrasive wheels and belts used in grinding to be iron free and not having been used on carbon steel. In all cases, the grain or rough finish to be removed by successively finer polishing operations to be consistent with reasonable care and good workmanship. Final polishing operations to be uniform and smooth.
2. Where break band occurs, free of open texture or orange peel appearance, all such marks shall be removed by grinding, polishing and finishing. Wherever sheared edges occur, they shall be free from burrs, projections and fins to obviate all danger from cutting or laceration when hand is drawn over such sheared edges.
3. Where miters or bullnosed corner, they will be neatly ground to uniform condition and in no case will overlapping materials be acceptable.
4. Equipment quality finish consistent with high grade of manufacturing practiced in industry. All exposed surfaces to be commercial mill finishes known as #4 satin finish for corrosion resistant steel. All exposed edges to be furnished with a #7 mirror finish, unless otherwise noted in item specifications.
5. All cabinets, doors and shelves where exposed to be interpreted as meaning inside surface exposed to view when swinging door or sliding doors are opened. Unless otherwise specified, underside of shelves need not be satin finish.

B. Doors - Hinged

1. To be full height of door opening. Each door shall not be over 30" wide for high cabinets and 24" wide for low cabinets. Doors to be double pan construction flush type and braced and thoroughly sound deadened made of 18 ga. st. st. Inner and outer pans to be sealed with 3/4" long tack welds spaces approximately 6" apart. Balance of the space to be completely sealed between tack welds with silver solder or N.S.F. approved hard solder (Silicone not approved).
2. All welds ground and polished smooth. All bracings to be on proper centers to fit door size.
3. Doors to be mounted on heavy semi concealed nickel bronze olive knuckle hinges fastened to inside ledge of door and cabinet so that only pin will be exposed to heavy st. st. piano hinges. Provide each door with Component Hardware #M22-2420.

C. Doors - Sliding

1. Make same as specified for hinged doors, except they shall operate on Component Hardware #B58-5513 and #B58-5523 nylon tire wheels running on one (1) piece drawn aluminum overhead Component Hardware #B57 tracks. Bottom shall be guided by st. st. Component Hardware #B56-1096 guide pins at center of door openings. Provide locks where called for in item specifications. Provide flush type polished handles. (Heated cabinets with sliding doors to use Component Hardware #B58-5511 and #B58-5523 st. st. ball bearing wheels).
2. "High" type fixtures to be fitted with two (2) sets of doors in height, each set opening into half height of fixture.
3. "Low" type fixtures to be fitted with (1) set of full height doors. No door length to exceed 36".

D. Sinks

1. All sinks to be made of 14 ga. st. st. unless otherwise specified. All corners shall be coved at least 5/8" radius, with all corners and joints welded, ground and polished smooth to a #4 satin finish. Sinks, unless otherwise specified, shall not be less than 14" deep. The use of solder or separate filler pieces to obtain coved corners will not be acceptable. All sink bottoms are to be integrally pitched to insure complete drainage of sink to waste opening. Edges at table height to have exposed edges formed to match adjoining table. Edges adjacent to table to be welded to table with all welds ground and polished smooth.
2. Unless otherwise specified, all sinks to be provided with backsplash 12" high x 2-1/2" wide to allow for pipe space in rear. Flange over at ends, with top edge turned back 2-1/2" at 45 degree angle and down 1". Provide openings for combination swinging type water faucet for each compartment.
3. In sinks of two (2) or more compartments, furnish between each sink compartment a 3/4" wide full height portion integrally welded to sinks at front, back and bottom maintaining smooth 5/8" radius coved corners as described in preceding paragraph.
4. Front of multiple compartment sinks shall consist of st. st. apron same gauge as sinks having length same as overall length of sink bowls and same depth as bowls. This apron shall be "L" shaped and welded to or part of the top rim.
5. Design of apron front to be such that sinks shall have an appearance of a continuous one (1) piece front face of all overlapping joints and open spaces between sink compartments.
6. Each compartment to be furnished with Component Hardware rotary handle type drain, connected rear overflow, 6" tailpiece and faucet of make and model number as called for in Item Specifications. Also each sink to be furnished with 14 ga. st. st. waste handle bracket welded to underside of sink.

E. Tables & Tops - Height

1. All working tops to be 34" high from floor, unless otherwise stated under specific item.

F. Metal Tops

1. Unless otherwise specified in Item Specifications, metal tops to be 14 ga. st. st. reinforced and braced on underside by framework consisting of 1-1/2" x 1-1/2" x 3/16" angles and 1" x 3" x 3/16" channels, galvanized where concealed and st. st. where exposed.
2. Framework angles to run full length and width and with angle crossbrace on not over 2'-6" centers. Channel reinforcing to run full length of tops down center of top. All tops with sinks shall be integrally pitched towards same.
3. All joints of framework to be welded with weld re-metalized. Tops to be bolted to framework in a concealed manner with st. st. bolts similar to AN-COR-LOX cup nuts. All metal tops to appear as one piece with all field and shop joints reinforced and welded, ground smooth, and polished, also to be made of largest piece obtainable.
4. No short pieces of metal will be acceptable. St. st. tops to have a #4 satin finish and all tops of this metal to be full 1/2" cove at re-entrant corners, also where turned up in rear or in front, such as dishtables. Solder filled corners will not be acceptable.
5. Metal edges to be made as described below and/or shown on detail drawings. Top to have all edges turned down 1-3/4" then back 1/2" at a 70 degree angle all around with all corners welded, ground, and polished smooth with no cracks or openings showing. All exterior corners to be well rounded bullnosed in 1-1/4" radius.

G. Dishtables & Pot Washing Tables

1. All free edges to be turned up 2-3/4" then rolled to 1-5/8" x 180 degrees and furnished with apron edge front, as per Edge Detail Sheet. All exposed and exterior corners to be coved at 5/8" radius with all joints welded, ground, and polished smooth.
2. Where tables abut a wall or other tall equipment, extend back and/or ends up 12" then back 2-1/2" at 45 degrees and down 1" parallel to wall. Provide with end filler pieces and all welded surfaces ground and polished smooth.
3. The underside of Dish and Pot Washing tables to be reinforced with 1-1/2" x 1-1/2" x 3/16" st. st. angles and 1" x 3" st. st. channels. Angles to run full length of tops at both front and rear of tops with crossbrace front to back on 2'-6" centers. Channel bracing to run down center, full length of tops. Tops shall be integrally pitched to dishwasher and sinks.

H. Fastening Tops to Washers and Other Equipment

1. Where tops are shown adjacent to dish or glass washer, etc., ends are to be turned down 1-1/2" into fixture and bolted tightly to it with approved gaskets between body and turned down edges. Backsplashes to have edge against fixture turned out 1-1/2" and tightly fitted to it. Free edges to be neatly fitted to fixture corners to prevent water from dripping on floor. All tops to have integral pitch to drain towards dishwasher.

I. Dish & Pot Table Drainage

1. During installation of dish tables and dishwasher, FSEC shall water test all counter tops to make sure of proper pitch before final plumbing and electrical connections are made. All water on counter tops shall drain with no standing puddles allowed. Should the FSEC fail to pitch tables properly, he shall be responsible for disconnecting plumbing and electrical connections and re-adjust tables to insure proper pitch. FSEC shall also be responsible for re-connecting all service lines after tables have been re-aligned.

J. Pipe Stands

1. All equipment requiring pipe legs or stands to be provided with sufficient supports to carry superimposed load of 100 lbs. per sq. ft. Top to be fabricated of 16 ga. st. st. Tubing to be Component Hardware #A46-5288 complete leg assembly Model Number 2236HB, 1-5/8" O.D., with st. st. hex head bullet shaped feet as previously specified. All pipe stands to be braced with crossrails, Component Hardware #A46-4288, 1-5/8" st. st. pipe welded to legs approximately 10" above floor or braced by lower shelf as specified hereinafter. Provide Component Hardware #A18-0206 st. st. gussets as previously specified, welded to framework on underside of top.
2. In place of gussets, st. st. legs may be welded to st. st. channels 5" long which shall fit into channel crossbracing. Flange of both channels to be machine bolted together. Holes for bolts to be slotted for adjustment. Provide legs on not over 5'-0" centers and additional if required or requested.
3. All pipe legs or vertical members to be set back from table top on ends and on front and back sufficient distance to offset any interference with workers, columns, walls or other items. Where tops are welded to sinks, omit pipe legs supporting top at sink location.

K. Shelves Under Tables

1. Under tops which are mounted on pipe legs or stands, shelves under table to be fabricated of 16 ga. st. st. with all edges flanged down 1-1/2" or as otherwise noted in the Item Specifications. Shelves to fit tightly around contour of legs and welded from underside. Shelves to be made up from long lengths with all joints welded, ground, and polished smooth.
2. Short lengths will not be permitted. Reinforced, as required, to support

load of 50 lbs. per sq. ft. All sharp edges, burrs, and corners to be ground smooth and removed and then be slightly rounded. All shelves in cabinet bases are to be angle reinforced.

L. Cabinet Bases

1. Exterior cabinet bases to be constructed of 18 ga. st. st. with front face, exposed ends, rear, and corners integrally exposed with all welds ground and polished smooth to form a one piece construction appearance.
2. St. st. exterior to be mounted over a 1-1/2" x 1-1/2" x 1/8" all welded galvanized iron angle frame. Where st. st. exterior meets angle framework at drawer, door or shelf openings, exterior shall be turned in 1-1/2" over angle framework inside of openings. All drawers and doors to be flush with cabinet face.
3. All cabinet base bottoms to be enclosed with 18 ga. galvanized iron panels. Interior shelves of cabinet base to be constructed of 16 ga. st. st. and be reinforced with 1-1/2" x 1-1/2" x 1/8" angles. Rear and ends of shelves to be turned up 2" with all interior corners coved to 5/8" radius.

M. Drawers

1. Drawer front to be 3/4" thick double pan construction with 16 ga. st. st. telescoping rear panels. Joints to be sealed same as specified for double pan hinged doors. Drawer front fitted with recessed st. st. grip handle, Component Hardware #CAGP63-1012. Drawer to be furnished with 18 ga. galvanized iron bottom with openings in front to accommodate drawer. Provide with cylinder type lock when specified under Item Specifications or shown on elevation details.
2. Opening in front to have edges turned in to fit drawer front which will be flush when drawer is closed. Bottom of enclosure to be open with edges turned in 1" on all sides.
3. All corners on enclosure to be continuously welded, then polished and ground smooth. Exposed rivets or screws will not be acceptable. Component Hardware #S81-2020 Drawer insert to consist of removable die-stamped 18 ga. st. st. pan approximately 20" square x 5" deep. Top edges of drawer insert to be flanged out on all sides, not less than 1/2" for resting on drawer extension glides. All sharp edges and burrs to be removed from drawer flange.
4. Housing supports to be made of 12 ga. st. st. formed into angles welded to underside of metal tops or screwed to underside of wood tops and to extend full width of top with rear enclosure, where exposed. All welded items to be ground and polished smooth. Screws for wood tops to be st. st. countersunk. Drawer housings to slide on 14 ga. st. st. telescoping channels with st. st. rollers, Component Hardware #S52 series extension roller slides.

N. Drawers

1. This mechanism must be designed so that drawer will not tilt when fully opened. Provide with stop mechanism to prevent pulling the housing from slides but with suitable extension so it may be removed for cleaning.

O. Tier of Drawers

1. To be two (2) or three (3) in number of same size as specified for above and entirely enclosed with 18 ga. st. st. same as specified under cabinet bases with openings for drawers with all joints flush welded, grounded, and polished smooth.
2. Single drawers under table tops to be one inch (1") back of edge of fixture. All draws shall have front flush with cabinet body.

P. Fasteners

1. Exposed screw or bolt heads will not be permitted on fixtures. Rivets, if specified, shall be countersunk flush. Rivets to be same material as they join. Butt joints made by riveting straps under seams and then filling with solder or caulking will not be permitted or accepted.

Q. Name Plates

1. All buy-out equipment shall be furnished with a permanently affixed metal name plate listing manufacturer's name, model number, voltage, cycle, phase, horsepower, etc., in an easily readable location. Dealers, installers, fabricators or service agencies name plate stickers shall not be fastened to any item without the approval of the Architect or Consultant.

2.3 MATERIALS AND WORKMANSHIP

- A. Unless otherwise specified, all material shall be new and of best quality, perfect, and without flaws and shall be delivered upon completion in an undamaged condition.

B. Stainless Steel

1. Shall be type 304 having a standard analysis of 18% chrome and 8% nickel. St. st. to be as manufactured by Republic Steel Company, "Endure", Allegheny Metal Company, Crucible Steel Company, "Rezistal" or approved equal. Gauge to be specified under Item Specifications and furnished with #4 satin finish, unless otherwise specified.

C. Galvanized Iron

1. Shall be American Rolling Mills "Armco", Republic Steel, Inland Steel, "Tocan" or approved equal.
2. Pipe legs shall be Standard-Keil #2235HB, 16 ga. st. st. (0.65" thick), tubing furnished with st. st. adjustable foot and Standard-Keil #481-58 with

enclosed gusset welded to underside of table top reinforcing channel.

3. Tubing to be seamless drawn, ground, and polished smooth to a #4 satin finish. Bottom of legs to be swedged for close fit to adjustable foot. Where space permits furnish 1-1/4" dia. st. st. crossrails welded to leg uprights. All welds shall have radius corners and be ground and polished smooth to a #4 satin finish.

D. Handles, Hinges & Door Fasteners

1. All hardware and other fittings used in connection with the equipment to be cast nickel bronze or st. st. Handles to be welded or bolted to the equipment in a concealed manner. Bolts to be st. st. and hinges to be recessed in door with st. st. Component Hardware #M75-1002 lift-off, N.S.F. approved hinge. Hinges to be fastened in place with st. st. recessed rivets or welded in place with weld ground and polished smooth.
2. Sliding doors to be depressed type and furnished with Component Hardware Model #P62-1010 handles. Hinges to be olive knuckle, semi concealed type of nickel bronze or st. st. piano type as described under the specific item.

E. Painting and Coating

1. All metal that is not st. st. is to be painted with two (2) coats of an approved rust-proof paint such as Rustoleum or other approved equal of highest quality gray enamel.

F. Electric Receptacles

1. All 120V-1 phase duplex receptacles in cabinet bases to be Pass & Seymour Model #6307 and receptacles over 120 volt shall be Hubbel receptacles sized as per the rough-in drawings.
2. All receptacles are to be grounded type being both dust and moisture proof. Furnish outlets with st. st. face plates and neoprene mats. In cabinet bases, all receptacles are to be mounted in Chase #R-1 all covered corners st. st. recessed type enclosure mounted to cabinet base. Component Hardware #R73 -1210 receptacles shall be pre-wired by FSEC to junction box in bottom of base cabinet left ready for final connection by Electrical Trades. All wiring between receptacles and junction box to be run in rigid conduit.
3. All counter top receptacles to be Component Hardware #R58 chrome plated type as specified in Item Specifications. Counter top receptacles to be pre-wired to junction box in rigid conduit same as previously specified. All wiring to be in strict compliance with latest standards of the National Sanitation Foundation and Board of Health Requirements.
4. Quietness of operation of all food service equipment is a requirement and the FSEC shall be required to remove or repair any equipment producing objectionable noises.

G. Shop Drawing Review

1. All submittals to be reviewed, stamped and dated by FSEC prior to sending them to the Contractor, Architect and Consultant. Submittals not bearing the FSEC's stamp will be rejected.
2. By reviewing and submitting shop drawings and samples, the FSEC thereby represents that he has verified all construction criteria, materials, catalog numbers and similar data and that he has checked and coordinated each shop drawing and sample with the requirements of the work and of the contract documents.
3. If shop drawings and/or samples are submitted without proper identification and in the Consultant's opinion it is evident that they have not been properly reviewed by the FSEC or if shop drawings are submitted in an unprofessional manner, they will be returned to the FSEC for identification and/or review and re-submission. In such an event, it will be held that the FSEC has not complied with the above requirements for reviewing and identifying shop drawings and samples. The FSEC shall bear the risk of all delays in work or in work of any other trade, the same as if no shop drawing or samples had been submitted. The above requirements will be strictly enforced.
4. The Consultant will review and process only two (2) submissions of each shop drawing and/or sample. Shop drawings and samples returned because the FSEC has not complied with the above requirements shall be counted as the first submission. If more than two (2) submissions are required, the FSEC shall pay the Consultant's cost for reviewing and processing the third and subsequent submissions. (Which will be so identified by the Consultant when returned to the FSEC)
5. The Consultant's cost shall be computed at two and one half (2-1/2) times payroll plus reproduction and mailing expense.

H. Buy-out Booklets

1. By submitting prepared Buy-out Booklets, the FSEC thereby represents that he has determined and verified voltage and phase requirements and that he has checked and coordinated each item with shop drawings and contract documents.
2. Each item in the Buy-out booklet shall have a typed title page, complete with descriptive details and included accessories.

2.4 TITLE PAGE TO BE AS PER THE FOLLOWING PAGE.

PART 3 EXECUTION

3.1 EXECUTION

A. Inspections

1. The Owner, Architect, and/or their duly authorized representative shall have free access to the contractor's shop or shops during the construction of this equipment for the purpose of making inspections to see that the plans and specifications and detailed drawings are being adhered to carefully.
- B. Contractor shall correct any errors found during the inspections, to the extent within the scope of the plans, specifications and detailed drawings.
- C. Upon being notified of job completion, it shall be the responsibility of the architect to inspect the job site and prepare an itemized Punch List.
- D. If items are found not to be complete per approved drawings, General Requirements and the Consultant's Item Specifications, upon receiving the Punch List, the FSEC shall correct all items on the list within thirty (30) days.
- E. It shall be the responsibility of the Plumbing and Electrical Trades to check all rough-in connections installed by their personnel to make sure that they agree with the dimensioned
- F. FSEC shall verify with the Electrical Trades the voltage and phase required for each piece of equipment that is to be supplied. Should the FSEC fail to verify the voltage characteristics it shall be his responsibility for changing the equipment on the job site to fit the voltage on the site.
- G. When deemed necessary by the Architect or the Consultant, the FSEC shall meet on the job site with the Electrical and Plumbing Trades to determine the best way of offsetting rough-in connections that interfere with beams, foundations, or other possible field obstructions.
- H. The FSEC shall check all base sizes, after installation by the Architectural Trades, to make sure that they will fit his equipment. Should base be installed incorrectly, the FSEC shall advise the Architectural Trades in writing at once to have base corrected as required.
- I. The FSEC shall check all walls where equipment abuts or fits between, after installation by the Architectural Trades, to make sure that the equipment will fit correctly.
- J. FSEC shall verify with the Electrical Trades the voltage and phase required for each piece of equipment that is to be supplied. Should the FSEC fail to verify the voltage characteristics it shall be his responsibility for changing the equipment on the job site to fit the voltage on the site.
- K. When deemed necessary by the Architect or the Consultant, the FSEC shall meet on the job site with the Electrical and Plumbing Trades to determine the best way of offsetting rough-in connections that interfere with beams, foundations or other possible field obstructions.
- L. The FSEC shall check all base sizes, after installation by the Architectural Trades, to make sure that they will fit his equipment. Should base be installed incorrectly, the FSEC shall advise the Architectural Trades in writing at once to have base corrected as required.

- M. FSEC shall verify with the Electrical Trades the voltage and phase required for each piece of equipment that is to be supplied. Should the FSEC fail to verify the voltage characteristics it shall be his responsibility for changing the equipment on the job site to fit the voltage on the site.

SAMPLE TITLE PAGE

Food Service Equipment Contractor _____

ITEM # _____ QUANTITY _____

Description: _____

Electrical

Motor H.P. _____ Volts _____ Phase _____ Cycle _____

Heating Element: KW _____ Volts _____ Phase _____

Lighting and/or Fan Circuit: _____ Volts _____ Phase _____

Refrigeration specs.

Plumbing

Cold Water _____ 140 degree water _____ 180 degree water _____

Steam in _____ Steam Pressure _____ Pounds _____

Steam Return _____ Connected Waste _____ Floor Waste _____

Gas

Kind _____ Size _____ B.T.U. _____

Spec. Gravity _____ Pressure _____

Direction of Feed for Dishwasher

Right to Left, Left to Right, Straight Thru, Corner type, Clockwise, and Counter Clockwise (circle unit required).

Door Hinged

Right Side, Left side (Circle unit required).

- N. FSEC shall verify with the Electrical Trades the voltage and phase required for each piece of equipment that is to be supplied. Should the FSEC fail to verify the voltage characteristics it shall be his responsibility for changing the equipment on the job site to fit the voltage on the site.
- O. When deemed necessary by the Architect or the Consultant, the FSEC shall meet on the job site with the Electrical and Plumbing Trades to determine the best way of offsetting rough-in connections that interfere with beams, foundations or other possible field obstructions.
- P. The FSEC shall check all base sizes, after installation by the Architectural Trades, to make sure that they will fit his equipment. Should base be installed incorrectly, the FSEC shall advise the Architectural Trades in writing at once to have base corrected as required.
- Q. The FSEC shall check all walls where equipment abuts or fits between, after installation by the Architectural Trades, to make sure that the equipment will fit correctly.

3.2 PREPARATION

- A. All gas equipment is to be furnished with appliance pressure regulators. Electrical requirements shall be in accordance with rough-in plan and verified on the job site.
- B. Should the electrical requirements and the item specifications not agree with the rough-in plan or electrical requirements on the job site, it shall be the responsibility of the FSEC to send a written report to the Architect and Consultant advising them of the discrepancy. Should the FSEC fail to verify voltages on the job site, it shall be his full responsibility to make all necessary changes on his equipment at no cost to the Owner.
- C. All measurements shall be verified at the building site and full responsibility for their correctness must be assumed by the Contractor.
- D. No extra charge or compensation will be allowed on account of difference between actual dimensions and the measurements indicated on the drawings. All or any differences which may be found shall be submitted to the Architect for consideration before proceeding with the work.

3.3 INSTALLATION

- A. Food Service Equipment
 - 1. FSEC shall be responsible for assembly and erection of all equipment included herein and in required location as shown on drawings, leaving same with outlets for other contractors to make final steam, plumbing, electrical and ventilation connections.
 - 2. FSEC is to provide a competent foreman to supervise the erection and placing of equipment and to advise other Trades in regards to connections at time of installation. Where applicable, he shall deliver to other Trades all

plumbing, steam fittings, and electrical parts included with his equipment for their proper installation.

3. FSEC to have qualified personnel on job site while the Plumbing, Electrical, and H.V.A.C. Trades are making final connections between rough-in and equipment. Where necessary, FSEC is to move equipment to allow these Trades to make final connections.
4. Should the FSEC fail to assist the other Trades and final location of equipment is incorrect, it shall be the responsibility of the FSEC to move the equipment to correct location and assume the cost of disconnecting and reconnecting the service connections.
5. FSEC is responsible for cutting all holes thru tops, backsplashes, shelves and cabinets so the other Trades can make final connections to outlets in fixtures from his rough-in.
6. Should these Trades fail to check rough-in before slab is poured, they shall assume all responsibility for making necessary changes and paying all the costs involved. Should the dimensioned rough-in drawings be incorrect, it shall be the responsibility of the FSEC to assume costs involved for revising all connections involved in the dimensioned error.
7. FSEC shall verify with the Electrical Trades the voltage and phase required for each piece of equipment that is to be supplied. Should the FSEC fail to verify the voltage characteristics it shall be his responsibility for changing the equipment on the job site to fit the voltage on the site.
8. When deemed necessary by the Architect or the Consultant, the FSEC shall meet on the job site with the Electrical and Plumbing Trades to determine the best way of offsetting rough-in connections that interfere with beams, foundations or other possible field obstructions.

B. Rough-in Inspections

1. It shall be the responsibility of the Plumbing and Electrical Trades to check all rough-in connections installed by their personnel to make sure that they agree with the dimensioned rough-in drawings as prepared by the FSEC.
2. Should these Trades fail to check rough-in before slab is poured, they shall assume all responsibility for making necessary changes and paying all the costs involved. Should the dimensioned rough-in drawings be incorrect, it shall be the responsibility of the FSEC to assume costs involved for revising all connections involved in the dimensioned error.
3. FSEC to have qualified personnel on job site while the Plumbing, Electrical, and H.V.A.C.
4. Trades are making final connections between rough-in and equipment. Where necessary, FSEC is to move equipment to allow these Trades to make final connections. Should the FSEC fail to assist the other Trades and final location of equipment is incorrect, it shall be the responsibility of the FSEC to move the equipment to correct location and

assume the cost of disconnecting and reconnecting the service connections.

5. FSEC is responsible for cutting all holes thru tops, backsplashes, shelves and cabinets so the other Trades can make final connections to outlets in fixtures from his rough-in.
6. Should specified equipment arrive at the job site with incorrect finish, model number, damaged, etc. A replacement item must be ordered immediately. Should the project schedule require the incorrect unit for opening operation, existing unit is to be left in operation until replacement is available, at no cost to the owner. It shall be the responsibility of the FSEC to assume all costs for re-stocking, re-selling, etc., of the incorrect items that have been used by the Owner.
7. All holes or openings must be cut in a workmanlike manner, with all edges ground and polished smooth and free of sharp edges. Opening in rear of base cabinet must not be larger than 1" bigger than pipe extending thru cabinet. Oversize cutouts with rough edges will not be approved.
8. All faucets and waste assemblies to be furnished by the FSEC and to be turned over to the Plumbing Trades for their installation. NOTE! Faucets and waste assemblies to be tagged properly to insure proper installation of these items on the correct fixtures.

C. Ventilating Trades

1. This Trade will furnish all ductwork to openings on top hoods, furnished by the FSEC.

D. Electrical and Plumbing Trades

1. These Trades shall furnish all final electrical and plumbing connections between fixtures and rough-in outlets in walls or floors.
2. Internal connections on booster heater and disposer to be furnished by the Plumbing and Electrical Trades and proper installation of these above named items. FSEC shall also include detailed drawings showing proper location of all accessories. General Building Contractor shall furnish all masonry platforms, tile bases and floor depressions.

E. Trimming & Sealing Equipment

1. Space between units to walls, ceilings, and floors and adjoining units not portable and with enclosed bodies, shall be completely sealed against entrance of food particles or vermin by means of st. st. trim strips, welding or commercial joint material suitable to the nature of the equipment. Sealer when not exposed to extreme heat shall be silicone construction sealant in the appropriate color. Ends of hollow sections to be closed. Enclosed fixtures without legs mounted on masonry bases or floor shall be sealed watertight to base of floor.
2. All equipment setting on masonry bases will be constructed to overhang to

provide toe spaces, however, metal framework and/or housings are to be turned under a sufficient distance to overlap masonry base and eliminate openings at these points. Bases to be sealed with Dow Corning sealant #786 or approved G.E. sealant.

3. Caulking at all backsplash areas in pot washing, dishwashing and preparation sinks and counters shall not have any recessed or convex areas which will allow for debris and water to sit on caulk.
4. Upright penetrations in backsplash and counter tops to have gap sealed with silicone.

3.4 ADJUST & CLEAN

- A. FSEC shall adjust and lubricate all moving parts for smooth quiet operation. The FSEC shall touch up scratches, marred or abraded surfaces to restore equipment to the original condition.
- B. The FSEC shall also remove all crating and packing material from the job site and shall also remove fingerprints and leave equipment and adjacent equipment or surfaces clean.
- C. The FSEC shall be responsible for missing items unless he can produce signed receipts from the Owner's personnel that the items were received and accounted for. Owner cannot be responsible for items that were dropped off at the job site and were not signed for by the Owner's personnel or representatives.

3.5 DEMONSTRATION

- A. The FSEC shall arrange a demonstration date with the Owner and at the same time check out all loose items with the Food Service Manager. Copy of signed receipts shall be mailed to E. F. WHITNEY, INC., showing all loose items, such as st. pans, mixer attachments, etc.

3.6 GUARANTEE

- A. All items furnished by the Food Service Equipment Contractor as part of this Contract, shall be guaranteed against defects in workmanship and material for a period of one (1) year.
- B. Manufacturers of standard items of equipment as supplied under this Contract are to provide a one (1) year warranty on parts and labor.
- C. In addition, connected pieces of equipment requiring calibration are to be so calibrated by a qualified person as part of this Contract.
- D. Commencement date for warranty purposes is as follows:
 1. Connected equipment: - When equipment is started up for intended use."
 2. Non-connected equipment: - At date of Owner acceptance."

3.7 PROTECTION OF EQUIPMENT

- A. Fabricated fixtures such as custom st. st. & plastic laminate items are to have fiberboard or plywood taped to tops and exposed body panels. Protective covering is to be left in place until all trades are completed.
- B. Manufactured equipment is to have fiberboard or plywood tape as required per equipment shape and installation access requirements.
- C. Prohibited use of equipment; tool and material storage area, workbench, scaffold, stacking area, etc.

3.8 APPROVED CUSTOM ST. ST. FABRICATORS

- A. The following is a list of fabricators who have demonstrated the ability to provide quality equipment.
 - 1. Florida Stainless
 - a. Oviedo, FL
 - 2. American Stainless Steel Corp
 - a. Englewood, CO.
 - 3. PRS
 - a. Warren, MI
 - 4. Great Lakes Stainless
 - a. Traverse City, MI
 - 5. MCM Fixture Co.
 - a. Hazel Park, MI
 - 6. Midwest Stainless Fabricating Co.
 - a. Livonia, MI
 - 7. Nationwide Fabrication, Inc.
 - a. Northglenn, CO
 - 8. Stainless Fixtures Inc.
 - a. Pomona, CA
- B. Use of a food service equipment fabricator other than those listed must be specifically approved in writing by the consultant prior to submission of food service equipment bids on this project.

ITEM A: REFRIGERATOR, REACH-IN

QTY: AS INDICATED IN DRAWINGS

MFG/MODEL: True manufacturing T-49F-FLX-HC Refridgerator

CONST: Per manufacturers standards.

ACCESSORIES:

Two (2) Full height stainless steel doors
One (1) Set of Heavy Duty 6" High Casters with wheel locks
One (1) UL. approved grounded cord & plug
One (1) Automatic condensate evaporator
Six (6) Epoxy coated wire shelves per section
Three (3) Year service/labor policy
One (1) Lot Lifetime warranty on door handles and hinges
Five (5) Year non-prorated compressor Warranty.

Details: Refrigerator to have 48 cu. Ft. Capacity, size 54 1/8" w x 29 5/8" d x 78 1/4" high. Compressor to be top mounted, air cooled unit. Include self-closing doors, cylinder locks & Microprocessor Control System with LED Temperature Readout. Door swings hinged per plan.

Elect: Per electrical plan.

ITEM B: FREEZER, REACH-IN

QTY: AS INDICATED IN DRAWINGS

MFG/MODEL: True manufacturing T-49F-FLX-HC Refridgerator

CONST: Per manufacturers standards.

ACCESSORIES:

Two (2) Full height stainless steel doors
One (1) Set of Heavy Duty 6" High Casters with wheel locks
One (1) UL. approved grounded cord & plug
One (1) Automatic condensate evaporator
Six (6) Epoxy coated wire shelves per section
Three (3) Year service/labor policy
One (1) Lot Lifetime warranty on door handles and hinges
Five (5) Year non-prorated compressor Warranty.

Details: Refrigerator to have 48 cu. Ft. Capacity, size 54 1/8" w x 29 5/8" d x 78 1/4" high. Compressor to be top mounted, air cooled unit. Include self-closing doors, cylinder locks & Microprocessor Control System with LED Temperature Readout. Door swings hinged per plan.

Elect: Per electrical plan.

ITEM C: ST. ST. THREE COMPARTMENT SINK

One (1) Custom fabricated unit sized per plan x 2'-9" wide x 34" high to working surface.

TOP: Fabricated of 14 ga. st. st. w/front & exposed end furnished with type "D" raised rolled edges. Working surface to have integral pitch towards sink with top of rim parallel with floor.
NOTE! Edge in front of sink area to be 1-1/2" lower than edge on drainboards. Edges to be integrally tapered at both ends of sink as shown on elevation detail. Top reinforcing and No 4 edge finish furnished in accordance with general requirements and standard edge details.

BACKSPLASH: Rear and sides as shown on plan against walls or equipment to be furnished with 12" high integral backsplash. Top to be turned back at 45 degree angle with 1" return down parallel to wall. Furnish 14 ga. st. st. "Z" clips to hold backsplash tight to wall in neat and workmanlike manner. Provide clear silicone sealant to wall and equipment. Caulking to fill gap without any recessed areas which will allow for debris and water to sit on caulk. Caulking requirements to be typical of all areas.

See Edge Detail type "G" for construction requirements.

SINKS: In top, furnish three (3) integrally welded sink compartments per plan location. Sink compartments to be 21 x 28" x 14" deep. Bottom of each sink compartment furnished with die-stamped opening to accommodate waste flange. Sink bottom all coved cornered, pitched to waste and fabricated per General Requirements.

SINK TRIM: Three (3) compartment unit to be furnished with the following:

Two (2) T&S Model B-0290-112X (3/4" I.P.S) to fit in rear of Backsplash to accommodate 3/4" water lines. Right faucet to have Pre-rinse w/ 10" "Add a Faucet" (1) T&S Model B-0287-427-B, Remove T&S Model 114X, 12" spout and provide T&S Model 112x 10" spout.

Furnish each faucet complete with T&S Model B-0427 Assembly to facilitate fastening to Backsplash

Three (3) T&S Model B-3950-01 Twist Handle Drains with connected rear overflow & 010387-45 removable basket strainers. Twist Handle Drains Furnished with 14 ga. st. st. bracket welded to underside of sink.

Sink trim to be furnished with identification tags and signed over to Plumbing Trades for their internal and final connections to rough-in locations.

DISPOSER CUTOUTS - Where shown, top to be cut out to accommodate disposer cone specified under separate item. Cone to be continuously welded around full perimeter, then ground and polished smooth to a #4 satin finish. Under top furnish 14 ga. st. st. bracket to accommodate disposer control panel or switch. Rear backsplash to be punched out to accommodate vacuum breaker assembly specified under disposers item #24.

LEG SUPPORTS: Top and sink to be mounted on EFW all st. st. one (1) leg support. Gusset leg crossbrace and wall flange fabricated in accordance with isometric detail drawing attached to contract drawings.

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SHELF UNDER: Over tops, per plan or elevation, furnish 16 ga. st. st. removable shelf. Shelf to be rolled over crossrails in front and sides. Rear to be turned up 3" against walls or side equipment. Shelf to have all coved corners at not less than 5/8" radius.

Submit shop drawing for review and approval.

ITEM D: TABLE, WORK

QTY: AS INDICATED IN DRAWINGS

MFG/MODEL: ADVANCE TABCO model # KSS-306 st. st. work table furnished per manufacturers standards. Include the following:

One (1) Lot st. st. legs with adjustable bullet feet
One (1) St. St. Lower Shelf

ITEM E: TABLE, WORK

QTY: AS INDICATED IN DRAWINGS

MFG/MODEL: ADVANCE TABCO model # KSS-304 st. st. work table furnished per manufacturers standards. Include the following:

One (1) Lot st. st. legs with adjustable bullet feet
One (1) St. St. Lower Shelf

ITEM F: TABLE, WORK

QTY: AS INDICATED IN DRAWINGS

MFG/MODEL: ADVANCE TABCO model # KTMS-305 st. st. work table furnished per manufacturers standards. Include the following:

One (1) Lot st. st. legs with adjustable bullet feet
One (1) St. St. Lower Shelf

ITEM G: ICE MAKER

QTY: AS INDICATED IN DRAWINGS

MFG/MODEL: Manitowoc IYT0450A

CONST: Per manufacturers standards.

ACCESSORIES:

One (1) External Scoop Holder
One (1) iAuCS
One (1) Arctic Pure Water Filter

Elect: Per rough-in plan.

ITEM H: TABLE, MOBILE WORK

QTY: AS INDICATED IN DRAWINGS

MFG/MODEL: ADVANCE TABCO model # MS-305 st. st. work table furnished per manufacturers standards. Include the following:

One (1) Lot st. st. legs with Heavy Duty 5" High Casters with wheel locks
One (1) St. St. Lower Shelf

ITEM I: DROP-IN ICE BIN

QTY: AS INDICATED IN DRAWINGS

MFG/MODEL: ADVANCE TABCO model # D-36-IBL st. st. work table furnished per manufacturers standards.

Details: Drop-in Ice Bin to have 75 lb. ice Capacity, size 33" w x 16 1/2" d x 14" high. Include stainless steel sliding cover.

ITEM J: HAND SINK, WALL MOUNT

QTY: AS INDICATED ON DRAWINGS

MFG. & MODEL: ADVANCE #7-PS-20

CONST: Sink to be constructed of Stainless Steel Sink to be furnished with 8" backsplash with 2" return to wall and flange down.

ACCESSORIES: Furnish with strainer type 6" tailpiece and "P" trap all to be chrome plated brass. Faucet shall be T & S EC 1301 TMV or equal ADVANCE electronic gooseneck faucet, aerator, mixing valve, 120 Volt A.C. transformer. Soap and towel dispenser to be provided by owner.

DETAILS: Sink to be mounted with rim 34" above finished floor with rough-in for water and waste located 4-7/8" below the 6-1/2" deep sink.

ITEM K: DOUBLE BREWER

QTY: AS INDICATED IN DRAWINGS

MFG/MODEL: BUNN 51200.0100

CONST: Per manufacturers standards.

ACCESSORIES:

One (1) Twin Drip Tray Product #53452.0000
Two (2) SH Server, 1.5g Product #27850.0200

Details: Double Brewer size 21.9" w x 19.8" d x 32.9" high.

Elect: Per electrical drawings.

ITEM L: DUAL COFFEE BEAN GRINDER

QTY: AS INDICATED IN DRAWINGS

MFG/MODEL: Bunn FPG-2 DBC SST

CONST: Per manufacturers' standards.

ACCESSORIES:

One (1) Funnel AY Product #34559.0001

Details: Dual Coffee Bean Grinder size 8.3" w x 10.4" d x 22.4" high.

Elect: Per electrical drawings.

ITEM M: ESPRESSO MACHINE

QTY: AS INDICATED IN DRAWINGS

MFG/MODEL: Nouva Simonelli MAURE18VDG03ND0001

CONST: Per manufacturers standards.

Details: Espresso Machine size 41" w x 24" d x 22" high.

Elect: Per electrical drawings.

ITEM N: UNDER-COUNTER DISHWASHER

QTY: AS INDICATED IN DRAWINGS

MFG/MODEL: CMA DISHMACHINES 180UC

CONST: Per manufacturers' standards.

Details: Under-Counter Dishwasher size 24" w x 25" d x 34 1/4" high.

Elect: Per electrical drawings.

ITEM O: HAND SINK WITH SPLASH GUARDS, WALL MOUNT

QTY: AS INDICATED IN DRAWINGS

MFG. & MODEL: ADVANCE #7-PS-40

CONST: Sink to be constructed of Stainless Steel Sink to be furnished with 8" backsplash with 2" return to wall and flange down.

ACCESSORIES: Furnish with strainer type 6" tailpiece and "P" trap all to be chrome plated brass. Faucet shall be T & S EC 1301 TMV or equal ADVANCE electronic gooseneck faucet, aerator, mixing valve, 120 Volt A.C. transformer. Soap and towel dispenser to be provided by owner.

DETAILS: Sink to be mounted with rim 34" above finished floor with rough-in for water and waste located 4-7/8" below the 6-1/2" deep sink.

ITEM P: UNDER-COUNTER REFRIDGERATOR

QTY: AS INDICATED IN DRAWINGS

MFG/MODEL: True Manufacturing TUC-27-HC-SPEC3

CONST: Per manufacturers standards.

ACCESSORIES:

One (1) Set of Heavy Duty 5" High Casters with wheel locks
One (1) UL approved grounded cord & plug
One (1) Automatic condensate evaporator

Details: Under-Counter Refrigerator size 27 9/16" w x 31 1/16" d x 36" high.

Elect: Per rough-in plan.

ITEM Q: DISPOSER, GARBAGE

QTY: One (1) Lot

MFG/MODEL: IN-SINK-ERATOR SS-200-15B-AS101 AQUA SAVER

CONSTRUCTION: Unit shall be a commercial, heavy-duty disposer with two (2) horsepower motor, stainless steel and chrome plated finish. Control Panel shall be 18 gauge st. st. NEMA 4, waterproof enclosure.

ACCESSORIES:

One (1) 15" cone w/ two fixed nozzles
One (1) St. St. Removable Cover and Scrap Block
One (1) Automatic Reversing Feature
One (1) Time Delay Relay set for 30 seconds
One (1) 24 volt line voltage transformer, controls operate on 24 volts
One (1) Line Disconnect Switch, Interlocks with front cover
One (1) Start/Stop Push Button
Two (2) Flow control valves and solenoids
One (1) St. st. support leg
One (1) 14 gauge st. st. mounting bracket
One (1) T&S B-2278 Pre-rinse unit w/ built in vacuum breaker & wall bracket
One (1) T&S B-0455 Vacuum Breaker Assembly w/ chrome plated pipe extension & elbows above backsplash area

DETAILS: Cone to be continuously welded to top with all welds ground and polished smooth. Control panel bracket welded to underside to top and set back so disconnect handle does not project beyond edge of table. Backsplash to be pre-drilled on exact centers to accommodate Vacuum Breaker Assembly. FSEC shall tag all accessories with item numbers and locations of equipment. Accessories are then to be delivered to Plumbing and Electrical Contractors for their internal and final connections. FSEC shall furnish detailed drawings showing proper installation of loose accessories and piping details.

ITEM R: WIRE SHELVING

QTY: (1) One lot arranged per plan.

MFG & MODEL: InterMetro Industries Corp Super Brite Super Erecta Shelving.

CONST: All carbon steel construction. Shelves to have 10 ga. mat wires spaced 21/32" apart. Mat wires to be supported by 6 ga. support wire. Support wire spacing specific to shelf size. Shelf width greater than 18" include one to two 7 ga. snake wire supports running the length of the shelf. Shelf frame to be made up of 7 ga. snake wire with two 6 ga. snake support wire. A round 1 1/2" steel collar is welded at each corner. All contact points are to be welded.

Posts are to be provided as 1" O.D. Round tubes notched every 1" of the post. A polypropylene post cap will be installed on the top of each post. The bottom of the post to have F04-004 hex head leveler and C03-002 post insert for the purpose of leveling the shelving.

Finish will be Super Brite, a zinc based chromate bath.

DETAILS: Each shelving to be furnished five (5) tiers high with four (4) 86" high posts. Shelving size and quantity to be sized per plan. Shared uprights will not be accepted.

ITEM S: MICROWAVE WALL SHELVING

QTY: AS INDICATED IN DRAWINGS

MFG/MODEL: ADVANCE TABCO #MS-20-30

CONST: Per manufacturers' standards.

ITEM T: WATER STATION WITH ICE BIN

QTY: AS INDICATED IN DRAWINGS

MFG/MODEL: ADVANCE TABCO #D-24-WSIBL2

CONST: Per manufacturers standards.

Details: Water Station w/ Ice Bin size 18" w x 21" d x 12" high. 50lb Ice Capacity.

ITEM U: CUSTOM MILLWORK SHELVING

CUSTOM PER DETAILS IN DRAWINGS

ITEM V: BEVERAGE CONTAINER

QTY: AS INDICATED IN DRAWINGS

MFG/MODEL: CATER GATOR 215BEVDP5BK

CONST: Per manufacturers' standards.

Details: Beverage Container size 17" w x 10 1/2" d x 25 3/4" high. 5 gal. Capacity.

ITEM W: WIRE WALL SHELVING

One (1) Lot Metro SuperBright wire wall shelving sized per plan. Unit to consist of two (2) 14" deep chrome shelves with two (2) 2WD14C chrome wire wall supports. Each chrome wire wall support consists of one shelf support and mount plate with two caps. FSEC to mount wire shelf supports to wall with heavy duty wall anchors and st. st. screws.

ITEM # 39 FIELD ERECTION LABOR

FSEC shall deliver, unload, uncrate, and install all items herein specified ready for final plumbing, electrical and ventilation connections furnished by respective trades as outlined in the General Requirements.

All equipment shall be cleaned and polished before demonstrating equipment to the Owner. All crating and packing material to be removed from job site.

FSEC shall arrange demonstration date with Owner and at the same time check out all loose items with the Food Service Manager.

FSEC shall be responsible for missing items unless he can produce signed receipts from Owner's personnel that the items were received and accounted for. Owner cannot be responsible for items delivered to the job site that were dropped off without being signed for by Owner's personnel or representatives.

Rough-in plans to be submitted at a scale of 1/4" = 1'-0". When present equipment is re-used at new locations, it shall be the FSEC'S responsibility to show necessary rough-in requirements for these items. (See General Requirements for complete details relating to submission of shop drawings). Two (2) Buyout Books to be sent to EFW for review and approval. Additional copies for use in field etc., to be made up as required after being check by EFW.

Two (2) complete sets of all final shop drawings, instructions, and parts lists are to be turned over to the Owner secured in a binder. This booklet shall include the telephone number and address of the service company for each piece of equipment.

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NOTE! FSEC shall pay all sales, consumer, use and other similar taxes for the work or portions thereof provided by the Contractor which are legally enacted at the time bids are received, whether or not yet effective.

Final payment cannot be recommended until all of the above items have been completed to our satisfaction.

END OF SECTION

NEW CONSTRUCTION FOR:
DOW GARDENS WELCOME CENTER
MIDLAND, MICHIGAN

PROJECT NO. 2022022

SECTION 11 4000.01 - ITEMIZED PROPOSAL FORM
DOW GARDENS WELCOME CENTER
MIDLAND, MICHIGAN

NAME OF BIDDER: _____

ADDRESS: _____

DATE: _____ TELEPHONE NO _____

BASE BID

If this Proposal is accepted in writing within thirty (30) days from the date of the bid opening, undersigned having familiarized themselves with the drawings and specifications as prepared by E. F. WHITNEY, INC., agrees to enter into a Contract for furnishing all labor, materials, and facilities for Food Service Equipment in connection with the above named project for the total base bid sum amount of \$ _____ including sales tax.

(\$ _____ DOLLARS)

The amount shown shall be shown both words and figures. In case of a discrepancy, the amount shown in words shall govern. Sales tax amount must be shown.

TIME OF COMPLETION

The Bidder agrees to complete the above named project in _____ consecutive calendar days.

BID GUARANTEE TYPE: _____

AMOUNT \$ _____

CONTRACT ASSUMPTIONS

The Bidder agrees to enter into a sub contract with the General Construction Work Contractor, (Architectural Trades) as designated by the Owner. The sub contract shall be based upon the prices, terms, and conditions set forth in the Proposal.

ADDENDA

Proposal is based on the following Addenda:

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MIDLAND, MICHIGAN

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Addendum # _____ Dated: _____

Addendum # _____ Dated: _____

Addendum # _____ Dated: _____

SIGNATURE

Signed By: _____

Dated and signed at: _____

State of _____ this _____ day of _____, 2021

LEGAL STATUS OF BIDDER

A Corporation duly organized and doing business under the laws of the State
of _____ for whom _____ whose signature is affixed to
this Proposal is duly authorized to execute contracts.

A Partnership, all members:

An individual whose signature is affixed to this Proposal:

INSTRUCTIONS

The Base Bid must be on fixtures specified for a fair comparison of all the bids. Prices on alternate equipment will be accepted on a separate sheet made up by the Bidder with illustrations and alternate specifications.

The following pages contain a schedule of the various items of equipment. All manufacturers names and other data requested must be filled in by the Bidder.

ON FABRICATED ITEMS, PLEASE GIVE THE NAME OF YOUR FABRICATOR

ITEM NUMBER	DESCRIPTION	QUANTITY	MANUFACTURER'S OR FABRICATOR'S NAME AND MODEL NUMBER	PRICE
A	REACH-IN REFRIDGERATOR			
B	REACH-IN FREEZER			
C	3- COMPARTMENT SINK			
D	STAINLESS STEEL WORK TABLE			
E	STAINLESS STEEL WORK TABLE			
F	STAINLESS STEEL WORK TABLE			
G	ICE MAKER			
H	MOBILE WORK TABLE			
I	DROP-IN ICE BIN			
J	HAND SINK			
K	DOUBLE BREWER			
L	DUAL COFFEE BEAN GRINDER			
M	ESPRESSO MACHINE			
N	UNDERCOUNTER DISHWASHER			
O	HAND SINK WITH SPASH GUARDS			
P	UNDERCOUNTER REFRIDGERATOR			
Q	GARBAGE DISPOSAL			
R	WIRE SHELVING			

NEW CONSTRUCTION FOR:
DOW GARDENS WELCOME CENTER
MIDLAND, MICHIGAN

PROJECT NO. 2022022

S	MICROWAVE SHELF			
T	WATER STATION WITH ICE BIN			
U	CUSTOM MILLWORK SHELVING			
V	BEVERAGE CONTAINERS			
W	WIRE WALL SHELVING			
X	FIELD ERECTION LABOR			

Sales Tax _____

TOTAL BASE BID _____

END OF SECTION 11 4000.01

SECTION 117300 - PATIENT CARE EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Ceiling-mounted patient-lift systems.

- B. Related Requirements:

- 1. Section 055000 "Metal Fabrications" for above-ceiling supplementary framing for support and anchorage of patient-lift systems.
- 2. Section 092216 "Non-Structural Metal Framing" for supplementary metal framing and blocking for mounting items requiring anchorage.
- 3. Section 102800 "Toilet, Bath, and Laundry Accessories" for specimen pass-through cabinets and boxes and for bedpan and urinal cabinets and boxes.

1.3 PREINSTALLATION MEETINGS

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

1.4 ACTION SUBMITTALS

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

- B. Shop Drawings:

- 1. Include plans, elevations, sections, and details.
- 2. Include details of components. Indicate location and size of each field connection.
- 3. Include diagrams for service connections and power, signal, and control wiring.

- C. Samples: For each exposed product and for each color and texture specified, 10 inches long in size.

- D. Samples for Initial Selection: For each type of exposed finish.

- 1. Include Samples of accessories involving color and finish selection.

- E. Samples for Verification: For each type of product required, prepared on Samples of size indicated below:
 - 1. Include Samples of accessories to verify color and finish selection.
 - 2. Ceiling-Mounted Patient-Lift Systems: Not less than 10-inch long, track sections.
- F. Delegated-Design Submittal: For above-ceiling supplementary framing for support and anchorage of patient-lift systems, signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: For ceiling-mounted patient-lift systems, reflected ceiling plan(s), and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Suspended ceiling components.
 - 2. Structural members to which ceiling-mounted patient-lift systems will be attached.
 - 3. Items penetrating finished ceiling including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Sprinklers.
 - d. Access panels.
 - 4. Perimeter moldings.
- B. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For products to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design above-ceiling supplementary framing for support and anchorage of patient-lift systems.

2.2 CEILING-MOUNTED PATIENT-LIFT SYSTEMS

- A. Ceiling-Mounted Patient Lift: Consisting of a motor-driven lift unit that traverses on a ceiling-mounted track system.
 - 1. Basis of Design Manufacturer: Amico Group of Companies, www.amico.com
- B. Ceiling-Mounted Track System: High-strength extruded aluminum in manufacturer's standard profile and thickness to support lifting capacity indicated for lift unit. Provide track shapes and accessories as required to provide a complete system in layout indicated on Drawings.
- C. Lift Unit: Steel frame system with separate 24-V dc lifting and horizontal-drive motors secured to chassis.
 - 1. Lifting Capacity: 440 lb.
 - 2. Maximum Lift Range: 96 inches.
 - 3. Safety Features:
 - a. Emergency stop.
 - b. Emergency lowering device, mechanical and electrical.
 - c. Control of lift strap.
 - d. Cut-off Angle: 45 degrees along the rail; 10 degrees across the rail.
 - 4. Electronics:
 - a. Control Unit: Walk-along, hand-held control unit.
 - b. On/Off Control: Soft start and stop with overload protection.
 - c. Battery Power: 24-V rechargeable nickel-metal hydride batteries in quantity required for lifting capacity indicated. Provide with electric battery charging station that provides maximum charge time of two hours per battery.
 - 1) Provide wall-mounted charging station at end of track. Provide supplemental clip-on charging station with indicator lights.
 - d. Battery Protection: Low-battery light illuminates when battery voltage is below 22 V; hoist disabled when battery voltage is below 20 V.
 - e. Motors: Provide in quantity required by lifting capacity indicated.
 - 1) Lift Motors: 2.3 inches per second lift speed at maximum capacity load.
 - 2) Horizontal-Drive Motors: 5.9 inches per second horizontal traverse at maximum capacity load.
- D. Accessories:
 - 1. Bariatric carry bar.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CEILING-MOUNTED PATIENT-LIFT SYSTEMS

- A. Install tracks level and plumb, according to manufacturer's written instructions.
 - 1. Support track directly from structure using manufacturer's standard supports, anchors, and fasteners at intervals required by lifting capacity indicated, but not less than 36 inches o.c.
 - 2. Brace direct-to-structure track supports where distance between suspended ceiling and anchors is more than 18 inches.
 - 3. Provide supports at each track end, splice, and tangent point of each corner.
 - 4. Install track accessories, splices, end caps, connectors, coupling and joining devices, and other accessories as required for a secure and operational installation.

3.3 ADJUSTING

- A. Adjust products for proper function and operation to comply with manufacturer's written instructions.

3.4 PROTECTION

- A. Protect installed products from damage for the remainder of the construction period.
- B. Repair damaged products according to manufacturer's written instructions. If damaged products cannot be successfully repaired, as determined by Architect, remove and replace damaged products.

END OF SECTION 117300

SECTION 122413 - ROLLER WINDOW SHADES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Manually operated roller shades with single rollers.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers, and their seam and batten locations.
- C. Selection Samples: For each finish product specified, provide two (2) samples representing manufacturer's full range of available colors, materials and patterns.

1.3 INFORMATIONAL SUBMITTALS

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

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.
- B. Warranty documentation.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A firm certified by Manufacturer to install specified products.

1.6 WARRANTY

- A. Manufacturer's Warranty and as follows:
 - 1. Hardware and Shade Fabric: Provide ten (10) year limited warranty.
 - 2. Roller Shade Components: Manufacturer's limited lifetime warranty against defects in materials and workmanship.
 - 3. Roller Shade Installation: One year from date of Substantial Completion.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not install roller shades until construction and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain roller shades from single source from single manufacturer.

2.2 MANUALLY OPERATED SHADES WITH SINGLE ROLLERS

- A. Manufacturers: Subject to compliance with requirements, provide products as manufactured by Mecho Shade Systems, Inc. as the Basis-of-Design.
- B. Equal products as manufactured by one of the following are also acceptable:
1. Draper Inc.
 2. Hunter Douglas Contract
 3. Legrand (Solarfective).
 4. Levolor
 5. Lutron Electronics Co., Inc.
 6. Substitutions: See Section 01 2500 - Substitution Procedures.
- C. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.
1. Chain-Retainer Type: Chain tensioner, jamb mounted.
 2. Spring Lift-Assist Mechanisms: Provide for shadebands that weigh more than 10 lb (4.5 kg) or for shades as recommended by manufacturer, whichever criterion is more stringent.
- D. Access and Material Requirements:
1. Provide shade hardware allowing for the removal of shade roller tube from brackets without removing hardware from opening and without requiring end or center supports to be removed.
 2. Provide shade hardware that allows for removal and re-mounting of the shade bands without having to remove the shade tube, drive or operating support brackets.
 3. Provide all shade installation hardware allowing for installation and removal of the shade without requiring the removal of hardware.
 - a. Brackets to be constructed of minimum 0.07 inch thick painted or nickel-plated, C1008/1010 cold rolled steel.
 - b. Painted brackets shall be finished with high quality baked enamel coating.
 - c. End plug bracket shall have a spring locking retainer device.
 - d. Brackets shall be reversible for right- or left-hand installation.
- E. Manual Operated Chain Drive Hardware and Brackets:
1. Provide for universal, regular and offset drive capacity, allowing drive chain to fall at front, rear or non-offset for all shade drive end brackets. Universal offset shall be adjustable for future change.
 2. Provide hardware capable for installation of a removable fascia, for both regular and/or reverse roll, which shall be installed without exposed fastening devices of any kind.
 3. Provide positive mechanical engagement of drive mechanism to shade roller tube. Friction fit connectors for drive mechanism connection to shade roller tube are not acceptable.
 4. Control system shall be constructed of fiberglass reinforced polyester thermos-polymer (PBT) resin, aluminum.
 5. Internal springs shall be constructed of tempered high carbon steel for smooth, trouble-free operation, precise control.
 6. Clutch shall develop no more than 1/2 pound drag for easy lift.
 7. System to be symmetrical for left or right hand installation.

8. Drive Chain: #10 qualified stainless-steel chain rated to 90 lbs. (41 kg) minimum breaking strength.

2.3 SHADEBAND MATERIALS

- A. Shadeband Material Flame-Resistance Rating: Comply with NFPA 701. Testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- B. Blackout Fabric:
 1. Basis Of Design: Hunter Douglas Sheerweave 7100
 1. Color: As indicated on drawings.
 2. Material Openness Factor: 0%.

2.4 SHADE BAND

- A. Shade Bands: Construction of shade bands includes the fabric, the hem weight, hem-pocket, shade roller tube, and the attachment of the shade to the roller tube. Sewn hems and open hem pockets are not acceptable.
 1. Hem Pockets and Hem Weights: Fabric hem pocket with welded seams (including welded ends) and concealed hem weights. Hem weights shall be of appropriate size and weight for shade band. Hem weight shall be continuous inside a sealed hem pocket. Hem pocket construction and hem weights shall be similar, for all shades within one room.
 2. Shade band and Shade Roller Attachment
 - a. Use extruded aluminum shade roller tube of a diameter and wall thickness required to support shade fabric without excessive deflection. Roller tubes less than 1.55 inch (39.37 mm) in diameter for manual shades are not acceptable.
 - b. Provide for positive mechanical engagement with drive / brake mechanism.
 - c. Provide for positive mechanical attachment of shade band to roller tube.

2.5 ROLLER SHADE FABRICATION

- A. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1
- B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F (23 deg C):
 1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which shade is installed less 1/4 inch (6 mm) per side or 1/2-inch (13-mm) total, plus or minus 1/8 inch (3.1 mm). Length equal to head-to-sill or -floor dimension of opening in which shade is installed less 1/4 inch (6 mm), plus or minus 1/8 inch (3.1 mm).
 2. Outside of Jamb Installation: Width and length as required, with terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.
- C. Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible, except as follows:
 1. Vertical Shades: Where width-to-length ratio of shadeband is equal to or greater than 1:4, provide battens and seams at uniform spacings along shadeband length to ensure shadeband tracking and alignment through its full range of movement without distortion of the material.
 2. Railroaded Materials: Railroad material where material roll width is less than the required width of shadeband and where indicated. Provide battens and seams as required by railroaded material to produce shadebands with full roll-width panel(s) plus, if required, one partial roll-width panel located at top of shadeband.

- D. Fabricate shade cloth to hand flat without buckling, distortion, waves, cupping, or wraps. Shade edges shall not fray, curl or unravel. Fabricate hem as follows:
 - 1. Standard Bottom Bar: Concealed heat seamed fabric, rolled over an aluminum bar.

2.6 ACCESSORIES

- A. Fascia:
 - 1. Continuous removable extruded aluminum fascia that attaches to shade mounting brackets without the use of adhesives, magnetic strips, or exposed fasteners.
 - 2. Fascia shall be able to be installed across two (2) or more shade bands in one piece.
 - 3. Fascia shall fully conceal brackets, shade roller and fabric on the tube.
 - 4. Provide bracket / fascia end caps where mounting conditions expose outside of roller shade brackets.
 - 5. Notching of Fascia for manual chain shall not be acceptable.
 - a. Color: Selected from manufacturer's standard colors.

PART 3 - EXECUTION

3.1 PROJECT CONDITIONS

- A. Comply with Environmental Requirements as follows:
 - 1. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.
 - 2. Install window treatments after finish Work including painting is complete and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

3.2 EXAMINATION

- A. Carefully examine installation areas with Installer present, for compliance with requirements affecting Work performance.
 - 1. Verification of Conditions: Verify that field measurements, surfaces, substrates, structural support, utility connections, tolerances, levelness, plumbness, humidity, moisture content level, cleanliness and other conditions are as required by the manufacturer, and ready to receive Work.
 - a. Verify each roller shade assembly will fit within its corresponding window shade pocket. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 ROLLER SHADE INSTALLATION

- A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions.
 - 1. Opaque Shadebands: Located so shadeband is not closer than 2 inches (51 mm) to interior face of glass. Allow clearances for window operation hardware.
- B. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

- C. Clean roller shade surfaces, after installation, according to manufacturer's written instructions.
- D. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.
- E. Perform required Demonstration and Training with Owner's designated staff.
 - 1. Engage Installer to train Owner's maintenance personnel to adjust, operate and maintain roller shade systems.

END OF SECTION 122413

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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 work of this Section.

1.2 SUMMARY

- A. This Section includes mechanical general administrative and procedural requirements. The following requirements are included in this Section to supplement the requirements specified in Division 01 Specification Sections.

1.3 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.

1. AABC - Associated Air Balance Council; www.aabc.com.
2. AASHTO - American Association of State Highway and Transportation Officials; www.transportation.org.
3. ABMA - American Bearing Manufacturers Association; www.americanbearings.org.
4. ABMA - American Boiler Manufacturers Association; www.abma.com.

5. AGA - American Gas Association; www.aga.org.
 6. AHRI - Air-Conditioning, Heating, and Refrigeration Institute (The); www.ahrinet.org.
 7. AMCA - Air Movement and Control Association International, Inc.; www.amca.org.
 8. ANSI - American National Standards Institute; www.ansi.org.
 9. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers; www.ashrae.org.
 10. ASME - ASME International; (American Society of Mechanical Engineers); www.asme.org.
 11. ASSE - American Society of Sanitary Engineering; www.asse-plumbing.org.
 12. ASTM - ASTM International; www.astm.org.
 13. AWS - American Welding Society; www.aws.org.
 14. AWWA - American Water Works Association; www.awwa.org.
 15. CDA - Copper Development Association; www.copper.org.
 16. CGA - Compressed Gas Association; www.cganet.com.
 17. CISPI - Cast Iron Soil Pipe Institute; www.cispi.org.
 18. CSA - CSA International; (Formerly: IAS - International Approval Services); www.csa-international.org.
 19. CSI - Construction Specifications Institute (The); www.csiresources.org.
 20. CTI - Cooling Technology Institute; (Formerly: Cooling Tower Institute); www.cti.org.
 21. FM Approvals - FM Approvals LLC; www.fmglobal.com.
 22. HI - Hydraulic Institute; www.pumps.org.
 23. ICC - International Code Council; www.iccsafe.org.
 24. IEEE - Institute of Electrical and Electronics Engineers, Inc. (The); www.ieee.org.
 25. IGSHPA - International Ground Source Heat Pump Association; www.igshpa.okstate.edu.
 26. Intertek - Intertek Group; (Formerly: ETL SEMCO; Intertek Testing Service NA); www.intertek.com.
 27. MSS - Manufacturers Standardization Society of The Valve and Fittings Industry Inc.; www.mss-hq.org.
 28. NADCA - National Air Duct Cleaners Association; www.nadca.com.
 29. NAIMA - North American Insulation Manufacturers Association; www.naima.org.
 30. NEBB - National Environmental Balancing Bureau; www.nebb.org.
 31. NECA - National Electrical Contractors Association; www.necanet.org.
 32. NEMA - National Electrical Manufacturers Association; www.nema.org.
 33. NETA - InterNational Electrical Testing Association; www.netaworld.org.
 34. NFPA - National Fire Protection Association; www.nfpa.org.
 35. NSF - NSF International; www.nsf.org.
 36. NSPE - National Society of Professional Engineers; www.nspe.org.
 37. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association; www.smacna.org.
 38. STI - Steel Tank Institute; www.steeltank.com.
 39. TEMA - Tubular Exchanger Manufacturers Association, Inc.; www.tema.org.
 40. UL - Underwriters Laboratories Inc.; www.ul.com.
 41. USGBC - U.S. Green Building Council; www.usgbc.org.
- 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.

1.4 PERFORMANCE REQUIREMENTS

- A. Systems Components Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

1.5 QUALITY ASSURANCE

- A. Scope of Work: Furnish all labor, material, equipment, technical supervision, and incidental services required to complete, test and leave ready for operation the mechanical systems as specified and as indicated on Drawings.

- 1. Contract Documents are complimentary, and what is required by one shall be as binding as if required by all. In the event of inconsistencies or disagreements within the Construction Documents bids shall be based on the most expensive combination of quality and quantity of the work indicated.

- B. Ordinances and Codes: Perform all Work in accordance with applicable Federal, State and local ordinances and regulations, the Rules and Regulations of ASHRAE, NFPA, SMACNA and UL, unless otherwise indicated.

- 1. Notify the Architect/Engineer in writing before submitting a proposal should any changes in Drawings or Specifications be required to conform to the above codes, rules or regulations.
- 2. If the Contractor performs any work knowing it to be contrary to such laws, ordinances, rules and regulations, and without notice to A/E, the Contractor shall bear all costs arising from corrective measures.

- C. Source Limitations: Obtain equipment and other components of the same or similar systems through one source from a single manufacturer.

- D. Tests and Inspections: Perform all tests required by state, city, county and/or other agencies having jurisdiction. Provide all materials, equipment, etc., and labor required for tests.

- E. Performance Requirements: Perform all work in a first class and workmanlike manner, in accordance with the latest accepted standards and practices for the trades involved.

- F. Sequence and Schedule: Perform work to avoid interference with the work of other trades. Remove and relocate work which in the opinion of the Owner's Representatives causes interference.

- G. Labeling Requirement for Packaged Equipment: Electrical panels on packaged mechanical equipment shall bear UL label or label of other Nationally Recognized Testing Laboratory (NRTL) (Intertek, CSA, etc.).

1.6 CODES, PERMITS AND FEES

- A. Unless otherwise indicated, all required permits, licenses, inspections, approvals and fees for Mechanical Work shall be secured and paid for by the Contractor. All Work shall conform to all applicable codes, rules and regulations.

- B. Rules of local utility companies shall be complied with. Check with each utility company supplying service to the installation and determine all devices including, but not limited to, all valves, meter boxes, and meters which will be required and include the cost of all such items in proposal.

- C. All work shall be executed in accordance with the rules and regulations set forth in local and state codes. Prepare any detailed drawings or diagrams which may be required by the governing authorities. Where the drawings and/or specifications indicate materials or construction in excess of code requirements, the drawings and/or specifications shall govern.
- D. Refer to Division 22 Section "Domestic Water Piping" for purchase and installation of potable water meters.

1.7 DRAWINGS

- A. The drawings show the location and general arrangement of equipment, piping and related items. They shall be followed as closely as elements of the construction will permit.
- B. Examine the drawings of other trades and verify the conditions governing the work on the job site. Arrange work accordingly. Provide fittings, valves, and accessories as required to meet actual conditions.
- C. Deviations from the drawings, with the exception of minor changes in routing and other such incidental changes that do not affect the functioning or serviceability of the systems, shall not be made without the written approval of the Architect/Engineer.
- D. The Architectural and Structural Drawings take precedence in all matters pertaining to the building structure, Mechanical Drawings in all matters pertaining to Mechanical Trades and Electrical Drawings in all matters pertaining to Electrical Trades. Where there are conflicts or differences between the drawings for the various trades, report such conflicts or differences to the Architect/Engineer for resolution.
- E. Drawings are not intended to be scaled for rough-in or to serve as shop drawings. Take all field measurements required to complete the Work.

1.8 MATERIAL AND EQUIPMENT MANUFACTURERS

- A. Equipment: All items of equipment shall be furnished complete with all accessories normally supplied with the catalog items listed and all other accessories necessary for a complete and satisfactory operating system. All equipment and materials shall be new and shall be standard products of manufacturers regularly engaged in the production of plumbing, heating, ventilating and air conditioning equipment and shall be the manufacturer's latest design.
- B. If an approved manufacturer is other than the manufacturer used as the basis for design, the equipment or product provided shall be equal in size, quality, durability, appearance, capacity, and efficiency through all ranges of operation, shall conform with arrangements and space limitations of the equipment shown on the plans and/or specified, shall be compatible with the other components of the system and shall comply with the requirements for Items Requiring Prior Approval specified in this section of the Specifications. All costs to make these items of equipment comply with these requirements including, but not limited to, piping, sheet metal, electrical work, and building alterations shall be included in the original Bid.
- C. All package unit equipment and skid mounted mechanical components that are factory assembled shall meet, in detail, the products named and specified within each section of the Mechanical and Electrical Specifications.

- D. Changes Involving Electrical Work: The design of the mechanical systems is based on the equipment scheduled on the Drawings. Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified with no additional cost to project. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.
 - 1. Where equipment changes are made that involve additional Electrical Work (larger size motor, additional wiring of equipment, etc.) the Mechanical Trades involved shall compensate the Electrical Trades for the cost of the additional Work required.

1.9 INSPECTION OF SITE

- A. Visit the site, examine and verify the conditions under which the Work must be conducted before submitting Proposal. The submitting of a Proposal implies that the Contractor has visited the site and understands the conditions under which the Work must be conducted. No additional charges will be allowed because of failure to make this examination or to include all materials and labor to complete the Work.
- B. No contract sum adjustments or contract time extensions will be made for Contractor claims arising from conditions which were or could have been observable, ascertainable or reasonably foreseeable from a site visit or inquiry into local conditions affecting the execution of the work.

1.10 ITEMS REQUIRING PRIOR APPROVAL

- A. Bids shall be based upon manufactured equipment specified. All items that the Contractor proposes to use in the Work that are not specifically named in the Contract Documents must be submitted for review prior to bids. Such items must be submitted in compliance with Division 01 specifications. Requests for prior approval must be accompanied by complete catalog information, including but not limited to, model, size, accessories, complete electrical information and performance data in the form given in the equipment schedule on the drawings at stated design conditions. Where items are referred to by symbolic designations on the drawings, all requests for prior approval shall bear the same designations.
 - 1. Equipment to be considered for prior approval shall be equal in quality, durability, appearance, capacity and efficiency through all ranges of operation, shall fulfill the requirements of equipment arrangement and space limitations of the equipment shown on the plans and/or specified and shall be compatible with the other components of the system.
 - 2. All costs incurred to make equipment comply with other requirements, including providing maintenance, clearance, piping, sheet metal, electrical, replacement of other components, and building alterations shall be included in the original bid.
- B. Voluntary alternates may be submitted for consideration, with listed addition or deduction to the bid, but will not affect the awarding of the contract.

1.11 ACTION SUBMITTALS

- A. Submit for review in compliance with Division 01.

- B. Equipment and material submittals required are indicated in the Mechanical; Fire Suppression; Plumbing; and Heating, Ventilating and Air Conditioning Sections. Refer to Division 01 for submittal quantities.
- C. Submittals shall be in groupings of similar or related items. Plumbing fixture submittals shall be in one package including all fixtures intended to be used for this project. Incomplete submittal groupings will be returned "Rejected". Submit product data with identification mark number or symbol numbers as specified or scheduled on the Mechanical Drawings.
- D. Submittals shall be project specific. Standard detail drawings and schedule not clearly indicating which data is associated with this Project will be returned "Rejected".
- E. If deviations (not substitutions) from Contract Documents are deemed necessary by the Contractor, details of such deviations, including changes in related portions of the project and the reasons therefore, shall be included with the submittal for approval.

1.12 INFORMATIONAL SUBMITTALS

A. Shop Drawings:

- 1. Prepare shop drawings to scale for the Architect/Engineer for review.
- 2. Shop drawings shall be reviewed by the Mechanical Contractor for completeness and accuracy prior to submitting to the Architect/Engineer for review. The shop drawings shall be dated and signed by the Mechanical Contractor prior to submission.
- 3. No equipment shall be shipped from stock or fabricated until shop drawings for them have been reviewed by the Architect/Engineer. Review is only for general conformance with the design concept of the project and general compliance with the information given in the Contract Documents. Any action indicated is subject to the requirement of the plans and specifications.
 - a. By the review of shop drawings, the Architect/Engineer does not assume responsibility for actual dimensions or for the fit of completed work in position, nor does such review relieve Mechanical Trades of full responsibility for the proper and correct execution of the work required.
 - b. Contractor is responsible for:
 - 1) Dimensions, which shall be confirmed and correlated at the job site.
 - 2) Fabrication processes and techniques of construction.
 - 3) Quantities.
 - 4) Coordination of Contractor's work with all other trades.
 - 5) Satisfactory performance of Contractor's work.
 - 6) Temporary aspects of the construction process.
- 4. Submit detailed shop drawings of piping systems showing pipe routing and types and locations of all pipe hangers.

B. Coordination Drawings:

- 1. Submit project specified coordination drawings for review in compliance with Division 01 Specification Sections.

1.13 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Instructional Manuals:

1. Submit project specific Operation and Maintenance Instructional Manuals for review in compliance with Division 01 Specification Sections.
 2. Provide complete operation and maintenance instructional manuals covering all mechanical equipment herein specified, together with parts lists. Maintenance and operating instructional manuals shall be job specific to this project. Generic manuals are not acceptable. One copy of all manuals shall be furnished for Owner. Maintenance and operating instructional manuals shall be provided when construction is approximately 75 percent complete.
 3. Format: Submit operation and maintenance manuals in the following format:
 - a. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Architect.
 - 1) Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
 - 2) Enable inserted reviewer comments on draft submittals.
 4. The operating and maintenance instructions shall include a brief, general description for all mechanical systems including, but not limited to:
 - a. Routine maintenance procedures.
 - b. Lubrication chart listing all types of lubricants to be used for each piece of equipment and the recommended frequency of lubrication.
 - c. Trouble-shooting procedures.
 - d. Contractor's telephone numbers for warranty repair service.
 - e. Submittals.
 - f. Recommended spare parts list.
 - g. Names and telephone numbers of major material suppliers and subcontractors.
 - h. System schematic drawings.
- B. Record Drawings:
1. Submit record drawings in compliance with Division 01.
 2. Contractor shall submit to the Architect/Engineer, record drawings on electronic media or vellum which have been neatly marked to represent as-built conditions for all new mechanical work.
 3. The Contractor shall keep accurate note of all deviations from the construction documents and discrepancies in the underground concealed conditions and other items of construction on field drawings as they occur. The marked up field documents shall be available for review by the Architect, Engineer and Owner at their request.
- C. Warranties:
1. Warranty: Comply with the requirements in Division 01 Specification Sections. Contractor shall warranty that the mechanical installation is free from defects and agrees to replace or repair, to the Owner's satisfaction, any part of this mechanical installation which becomes defective within a period of one year (unless specified otherwise in other Mechanical; Fire Suppression; Plumbing; or Heating, Ventilating and Air Conditioning Sections) from the date of substantial completion following final acceptance, provided that such failure is due to defects in the equipment, material, workmanship or failure to follow the contract documents.
 2. File with the Owner any and all warranties from the equipment manufacturers including the operating conditions and performance capacities they are based on.

1.14 INSTRUCTION OF OWNER PERSONNEL

- A. Before final inspection, instruct Owner's designated personnel in operation, adjustment, and maintenance of mechanical equipment and systems at agreed upon times. A minimum of 24 hours of formal instruction to Owner's personnel shall be provided for each building. Additional hours are specified in individual specification sections.
- B. For equipment requiring seasonal operation, perform instructions for other seasons within six months.
- C. Use operation and maintenance manuals as basis for instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.
- D. In addition to individual equipment training provide overview of each mechanical system. Utilize the as-built documents for this overview.
- E. Prepare and insert additional data in operation and maintenance manual when need for such data becomes apparent during instruction.

1.15 WARRANTY

- A. Warranty: Comply with the requirements in Division 01 Specification Sections. Contractor shall warranty that the mechanical installation is free from defects and agrees to replace or repair, to the Owner's satisfaction, any part of this mechanical installation which becomes defective within a period of one year (unless specified otherwise in other Mechanical; Fire Suppression; Plumbing; or Heating, Ventilating and Air Conditioning Sections) from the date of substantial completion following final acceptance, provided that such failure is due to defects in the equipment, material, workmanship or failure to follow the contract documents.
- B. File with the Owner any and all warranties from the equipment manufacturers including the operating conditions and performance capacities they are based on.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 REFRIGERANT HANDLING

- A. Refrigerant Installation and Disposal: Perform all work related to refrigerant contained in chillers, cooling coils, air conditioners, and similar equipment, including related piping, in strict accordance with the following requirements:
 - 1. ASHRAE Standard 15 and Related Revisions: Safety Code for Mechanical Refrigeration.
 - 2. ASHRAE Standard 34 and Related Revisions: Number Designation and Safety Classification of Refrigerants.
 - 3. United States Environmental Protection Agency (US EPA) requirements of Section 8 08 (Prohibition of Venting and Regulation of CFC) and applicable State and Local regulations of authorities having jurisdiction.

- B. Recovered refrigerant is the property of the Contractor. Dispose of refrigerant legally, in accordance with applicable rules and regulations.

3.2 WORK IN EXISTING BUILDINGS

- A. The Owner will provide access to existing buildings as required. Access requirements to occupied buildings shall be identified on the project schedule. The Contractor, once Work is started in the existing building, shall complete same without interruption so as to return work areas as soon as possible to Owner.
- B. Adequately protect and preserve all existing and newly installed Work. Promptly repair any damage to same at Contractor's expense.
- C. Consult with the Owner's Representative as to the methods of carrying on the Work so as not to interfere with the Owner's operation any more than absolutely necessary. Accordingly, all service lines shall be kept in operation as long as possible and the services shall only be interrupted at such time as will be designated by the Owner's Representative.
- D. Prior to starting work in any area, obtain approval for doing so from a qualified representative of the Owner who is designated and authorized by the Owner to perform testing and abatement, if necessary, of all hazardous materials including but not limited to, asbestos. The Contractor shall not perform any inspection, testing, containment, removal or other work that is related in any way whatsoever to hazardous materials under the Contract.

3.3 WORK INVOLVING OTHER TRADES

- A. Certain items of equipment or materials specified in the Mechanical Division may have to be installed by other trades due to code requirements or union jurisdictional requirements. In such instances, the Contractor shall complete the work through an approved, qualified subcontractor and shall include the full cost for same in proposal.

3.4 ACCEPTANCE PROCEDURE

- A. Upon successful completion of start-up and recalibration, but prior to building acceptance, substantial completion and commencement of warranties, the Architect/Engineer shall be requested in writing to observe the satisfactory operation of all mechanical control systems.
- B. The Contractor shall demonstrate operation of equipment and control systems, including each individual component, to the Owner and Architect/Engineer.
- C. After correcting all items appearing on the punch list, make a second written request to the Owner and Architect/Engineer for observation and approval.
- D. After all items on the punch list are corrected and formal approval of the mechanical systems is provided by the Architect/Engineer, the Contractor shall indicate to the Owner in writing the commencement of the warranty period.
- E. Operation of the following systems shall be demonstrated:
 - 1. Air Handling Systems.
 - 2. Chilled Water Systems.

3. Heating Systems.
4. Domestic Hot Water Heaters.
5. Domestic Hot Water Mixing Stations.
6. Chemical Treatment Systems.
7. Energy Recovery Systems.
8. Temperature Controls.
9. Building Automation System.
10. Exhaust Systems.

- F. For systems requiring seasonal operation, demonstrate system performance within six months when weather conditions are suitable.

END OF SECTION 200500

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 20 Section "Mechanical General Requirements."
2. Division 22 Section "Domestic Water Piping" for flushing and cleaning of potable water piping.
3. Division 23 Section "Piping Systems Flushing and Chemical Cleaning" for flushing and cleaning of HVAC piping.

1.2 SUMMARY

- A. This section includes mechanical materials and installation methods common to mechanical piping systems, sheet metal systems and equipment. This section supplements all other Division 20, 21, 22, and 23 Mechanical Sections, and Division 01 Specification Sections.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
1. ABS: Acrylonitrile-butadiene-styrene plastic.
 2. CPVC: Chlorinated polyvinyl chloride plastic.
 3. PE: Polyethylene plastic.
 4. PVC: Polyvinyl chloride plastic.
 5. RTRF: Reinforced thermosetting resin (fiberglass) fittings.
 6. RTRP: Reinforced thermosetting resin (fiberglass) pipe.
- G. The following are industry abbreviations for rubber materials:
1. EPDM: Ethylene-propylene-diene terpolymer rubber.
 2. NBR: Acrylonitrile-butadiene rubber.

1.4 ACTION SUBMITTALS

- A. Product Data: For the following:

1. Transition fittings.
2. Dielectric fittings.

3. Mechanical sleeve seals.
4. Escutcheons.

1.5 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Brazing Certificates: As required by ASME Boiler and Pressure Vessel Code, Section IX, or AWS B2.2.

1.6 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of Lead in Drinking Water Act," about lead content in materials that will be in contact with potable water for human consumption.
- B. Comply with NSF 14, "Plastics Piping System Components and Related Materials," for plastic, potable domestic water piping and components. Include marking "NSF-pw" on piping.
- C. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," for potable domestic water piping and components.
- D. Comply with NSF 372, "Drinking Water System Components - Lead Content" for potable domestic water piping and components.
- E. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- F. Duct Joint and Seam Welding: Qualify procedures and personnel according to the following:
 1. AWS D9.1, "Sheet Metal Welding Code."
- G. Structural Welding: Qualify procedures and personnel according to the following:
 1. AWS D1.1, "Structural Welding Code--Steel."
 2. AWS D1.2, "Structural Welding Code--Aluminum."
 3. AWS D1.3, "Structural Welding Code--Sheet Steel."
 4. AWS D1.4, "Structural Welding Code--Reinforcing Steel."
 5. AWS D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- H. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications," or AWS B2.2, "Standard for Brazing Procedure and Performance Qualification."
- I. Soldering: Qualify processes and operators according to AWS B2.3/2.3M, "Specification for Soldering Procedure and Performance Qualification."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Storage and Protection: Provide adequate weather protected storage space for all mechanical equipment and materials deliveries to the job site. Storage locations will be designated by the Owner's Representative. Equipment stored in unprotected areas must be provided with temporary protection.
1. Protect equipment and materials from theft, injury, or damage.
 2. Protect equipment outlets, pipe and duct openings with temporary plugs or caps.
 3. Materials with enamel or glaze surface shall be protected from damage by covering and/or coating as recommended in bulletin "Handling and Care of Enameled Cast Iron Plumbing Fixtures", issued by the Plumbing Fixtures Manufacturer Association, and as approved.
 4. Electrical equipment furnished by Mechanical Trades and installed by the Electrical Trades: Turn over to Electrical Trades in good condition, receive written confirmation of same.
 5. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
 6. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.8 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for mechanical installations. Coordinate with other trades to ensure accurate locations and sizes of mechanical spaces, chases, slots, shafts, recesses, and openings.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Install Work to avoid interference with work of other trades including, but not limited to, Architectural and Electrical Trades. Remove and relocate any work that causes an interference at Contractor's expense.
- D. Coordinate requirements for and provide access panels and doors for mechanical items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."
- E. The mechanical trades shall be responsible for all damage to other work caused by their work or through the neglect of their workers.
1. All patching and repair of any such damaged work shall be performed by the trades which installed the work. The cost shall be paid by the Mechanical Trades.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 21, 22, and 23 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

- A. Refer to individual Division 21, 22, and 23 piping Sections for special joining materials not listed below.
- B. Unions: Pipe Size 2 Inches and Smaller:
 1. Ferrous pipe: Malleable iron ground joint type unions.
 2. Unions in galvanized piping system shall be galvanized.
 3. Copper tube and pipe: Bronze unions with soldered joints.
- C. Flanges: Pipe Sizes 2-1/2 Inch and Larger:
 1. Ferrous pipe: Standard weight, forged steel weld neck flanges.
 2. Copper tube and pipe: Slip-on bronze flanges.
- D. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- E. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated. Square head bolts and nuts are not acceptable.
- F. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- G. Solder Filler Metals: ASTM B 32, lead-free, antimony-free, silver-bearing alloys. Include water-flushable flux according to ASTM B 813.
- H. Brazing Filler Metals: Alloys meeting AWS A5.8.
 1. Use Type BcuP Series, silver-bearing, copper-phosphorus alloys for joining copper or bronze socket fittings with copper pipe. Flux is prohibited unless used with bronze fittings.
 2. Use Type Bag Series, cadmium-free silver alloys for joining copper with steel, stainless steel, or other ferrous alloys.

- I. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- J. Welding Materials: Comply with Section II, Part C, of ASME Boiler and Pressure Vessel Code for welding materials appropriate for wall thickness and for chemical analysis of pipe being welded.
- K. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F 493.
- L. Solvent Cements for Joining PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
- M. Solvent Cements for Joining ABS Piping: ASTM D 2235.
- N. Solvent Cements for Joining PVC to ABS Piping Transition: ASTM D 3138.

2.4 PIPE THREAD COMPOUNDS

- A. General: Pipe thread compounds for the fluid service compatible with piping materials provided.
- B. Potable Water Service and Similar Applications: Compounds acceptable to U.S. Department of Agriculture (USDA) or Food and Drug Administration (FDA). Compounds containing lead are prohibited.
- C. Natural Gas System: Use either of the following:
 - 1. Tetrafluoroethylene (Teflon) tape 2 to 3 mils thick for threaded joints.
 - a. Manufacturers:
 - 1) Cadillac Plastic.
 - 2) Permacel.
 - 3) Other approved.
 - 2. Lead-free pipe thread compounds suitable for service.
 - a. Manufacturers:
 - 1) HCC Holdings, Inc.; Hercules Pro Dope.
 - 2) Mill-Rose Company (The); Clean-Fit Products; Blue Monster Thread Sealant.
 - 3) Oatey; Great Blue Pipe Joint Compound.
 - 4) RectorSeal LLC: A CSW Industrials Company; No. 5, No.5 Special, and No. 5 Sub-Zero Pipe Thread Sealants.

2.5 TRANSITION FITTINGS

- A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
 - 1. Manufacturers:
 - a. Cascade Waterworks Mfg. Co.
 - b. Dresser Industries, Inc.; DMD Div.

- c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
 - d. JCM Industries.
 - e. Smith-Blair, Inc.
 - f. Viking Johnson.
 2. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.
 3. Underground Piping NPS 2 and Larger: AWWA C219, metal sleeve-type coupling.
 4. Aboveground Pressure Piping: Pipe fitting.
 - B. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
 1. Manufacturers:
 - a. IPEX Inc. (formerly Esilon Thermoplastics).
 - C. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
 1. Manufacturers:
 - a. Thompson Plastics, Inc.
 - D. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.
 1. Manufacturers:
 - a. NIBCO INC.
 - b. NIBCO, Inc.; Chemtrol Div.
 - E. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.
 1. Manufacturers:
 - a. Cascade Waterworks Mfg. Co.
 - b. Fernco, Inc.
 - c. Mission Rubber Company.
 - d. Plastic Oddities, Inc.
 - e. Can-Tex Industries Division of Harsco Corp. "CT-Adaptors".
 - f. Joint Inc., "Caulder".
- 2.6 DIELECTRIC FITTINGS
- A. Insulating Material: Suitable for system fluid, pressure, and temperature.
 - B. Brass Unions, Brass Nipples, Brass Couplings: For systems up to 286 deg F.
 - C. Dielectric-Flange Kits: Include full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

1. Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Capitol Manufacturing Co.
 - d. GF Piping Systems; George Fischer Central Plastics.
 - e. Epco Sales, Inc.
 - f. Pipeline Seal and Insulator, Inc.
 - g. Watts Water Technologies, Inc.; Watts Regulator Co.
 - h. Zurn Industries, Inc.; Wilkins Div.
2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.

2.7 MODULAR MECHANICAL SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve or pipe and core drilled hole.
 1. Manufacturers:
 - a. Advance Products & Systems, Inc.; Innerlynx.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.; Thunderline Link Seal.
 2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 3. Pressure Plates: Stainless steel. Include two for each sealing element.
 4. Connecting Bolts and Nuts: Stainless steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.8 SLEEVES

- A. Steel Pipe: ASTM A53, Type E, Grade B, Schedule 40, and 0.375 inch wall black.
- B. Steel Pipe: ASTM A53, Type E, Grade B, Schedule 40, and 0.375 inch wall galvanized, plain ends.
- C. Water Stop: Cast or ductile-iron; fabricated steel; PVC; or rotationally molded HDPE pipe; with plain ends and integral water stop, unless otherwise indicated.
 1. Manufacturers:
 - a. Advance Products & Systems, Inc.; Infinity and Gal-Vo-Plast Sleeves.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 1. Underdeck Clamp: Clamping ring with set screws.

2.9 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
 - 1. New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping or Piping in High Humidity Areas: One-piece, cast-brass type with polished chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
 - d. Bare Piping in Finished Spaces: One-piece, stamped-steel type.
 - e. Bare Piping in Unfinished Service Spaces or Equipment Rooms: Split-plate, stamped-steel type with concealed hinge and set screw.

2.10 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

2.11 EPOXY BONDING COMPOUND

- A. Two-component system suitable for bonding wet or dry concrete to each other and to other materials.
- B. Manufacturers:
 - 1. Euco 452 #450; Euclid Chemical Co.
 - 2. Epobond; L & M Construction Chemicals.
 - 3. Sikadur 87; Sika Corp.

2.12 LEAK DETECTOR SOLUTION

- A. Commercial leak detector solution for pipe system testing.
- B. Manufacturers:
 - 1. American Gas and Chemicals Inc.; Leak Tec.
 - 2. Cole-Parmer Inst. Co.; Leak Detector.
 - 3. Guy Speaker Co. Inc.; Squirt 'n Bubbles.

2.13 PIPE PENETRATION ASSEMBLIES

- A. Contractor may choose from one of the following:
- B. Pipe Roof Penetration Enclosures

1. Manufacturers:
 - a. Pate Company (The); pca Series.
 - b. Portal Plus, Inc.
 - c. Thybar Corporation; Thycurb.
 2. Prefabricated roof curb with:
 - a. Minimum 18 gage welded galvanized steel construction.
 - b. Integral base plate.
 - c. Factory installed insect and decay resistant wood nailer.
 - d. EPDM compression molded rubber cap for single or multiple pipes as required. Quantity of molder rubber caps shall be sufficient for no more than one pipe or conduit per cap.
 - e. Stainless steel draw-band clamps.
- C. Pipe Roof Penetration Hood Assembly
1. Manufacturers:
 - a. Pate Company (The); pha Series.
 2. Heavy gage aluminum construction.
 3. Removable top cover.
 4. Fully insulated aluminum mounting base to isolate hood from galvanized curb.
 5. Includes prefabricated roof curb with:
 - a. Minimum 18 gage welded galvanized steel construction.
 - b. Integral base plate.
 - c. Factory installed insect and decay resistant wood nailer.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Refer to piping application schedules on the Drawings.
- B. Install piping according to the following requirements and Division 21, 22, and 23 Sections specifying piping systems, and in accordance with manufacturer's instructions.
- C. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. The Drawings shall be followed as closely as elements of construction will permit.
- D. During the progress of construction, protect open ends of pipe, fittings, and valves to prevent the admission of foreign matter. Place plugs or flanges in the ends of all installed work whenever work stops. Plugs shall be commercially manufactured products.
- E. Prior to and during laying of pipe, maintain excavations dry and clear of water and extraneous materials. Provide minimum 4 inches of clearance in all directions for pipe passing under or through building grade beams.

- F. Weld-o-lets and thread-o-lets can be used for annular flow measuring devices, temperature control components, and thermal wells in steel pipe. Pipe taps shall be drilled and deburred. Torch cutting is not acceptable.
- G. Brazolets can be used for annular flow measuring devices, temperature control components, and thermal wells in copper tube. Pipe taps shall be drilled and deburred. Torch cutting is not acceptable.
- H. Clean and lubricate elastomer joints prior to assembly.
- I. Clean damaged galvanized surfaces and touch-up with a zinc rich coating.
- J. Install piping to conserve building space and not interfere with use of space.
- K. Group piping whenever practical at common elevations.
- L. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
 - 1. Install piping to allow for expansion and contraction at locations where piping crosses building or structure expansion joints.
- M. Slope piping and arrange systems to drain at low points.
- N. Slope horizontal piping containing non-condensable gases 1 inch per 100 feet, upward in the direction of the flow.
- O. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- P. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- Q. In concealed locations where piping, other than black steel, cast-iron, or galvanized steel, is installed through holes or notches in studs, joists, rafters, or similar members less than 1-1/2 inches from the nearest edge of the member, the pipe shall be protected by shield plates. Protective shield plates shall be a minimum of 1/16 inch thick steel, shall cover the area of the pipe where the member is notched or bored, and shall extend a minimum of 2 inches above sole plates and below top plates.
- R. Do not penetrate building structural members unless specifically indicated on drawings.
- S. Install piping above accessible ceilings to allow sufficient space for ceiling panel and light fixture removal.
- T. Install valves with stems upright or horizontal, not inverted.
- U. Provide clearance for installation of insulation and access to valves and fittings.
- V. Install piping to permit valve and equipment servicing. Do not install piping below valves and/or terminal equipment. Do not install piping above electrical equipment.
- W. Install piping at indicated slopes. Provide drain valves with hose end connections and caps at all piping low points, where piping is trapped and at all equipment.

- X. Install piping free of sags and bends.
- Y. Install fittings for changes in direction and branch connections.
- Z. Unless otherwise indicated or specified, install branch connections to mains using tee fittings in main pipe:
 - 1. Branch connected to bottom of main pipe for HVAC systems. Side connection is acceptable. Connection above centerline of main is unacceptable. For up-feed risers, connect branch to top of main pipe.
 - 2. Branch connected to top of main for steam and condensate, plumbing systems, compressible gasses, and vacuum.
- AA. Install piping to allow application of insulation.
- BB. Select system components with pressure rating equal to or greater than system operating pressure.
- CC. After completion, fill, clean, and treat systems. Refer to Division 23 Sections "Hydronic Piping," "Piping Systems Flushing and Chemical Cleaning," and "HVAC Water Treatment."
- DD. Install escutcheons for penetrations of walls below ceiling, and ceilings.
- EE. Sleeves are not required for core-drilled holes in poured concrete walls.
- FF. Permanent sleeves are not required for holes formed by removable PE sleeves in poured concrete walls.
- GG. Install sleeves for pipes passing through footings and foundation walls, masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
 - 1. Cut sleeves to length for mounting flush with both surfaces of walls.
 - a. Exception: Extend sleeves installed in floors 2 inches above finished floor level.
 - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 - 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. Schedule 40 Black Steel Sleeves: For pipes smaller than NPS 12 penetrating interior walls.
 - b. 0.375 Inch Wall Black Steel Sleeves: For pipes NPS 12 and larger penetrating interior walls.
 - c. Schedule 40 Galvanized Steel Sleeves: For pipes smaller than NPS 12 penetrating floors, and roof slabs.
 - d. 0.375 Inch Wall Galvanized Steel Sleeves: For pipes NPS 12 and larger penetrating floors and roof slabs.
 - e. For pipes penetrating floors with membrane water proofing provide cast iron sleeve with clamping flanges. Secure/seal membrane to sleeves with clamping flanges.
 - 4. Seal sleeves in concrete floors roof slabs and masonry walls with grout.
 - 5. Seal sleeves in plaster/gypsum-board partitions with plaster or dry wall compound and caulk with non-hardening silicone sealant to provide airtight installation.

6. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- HH. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and modular mechanical seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing modular mechanical seals.
1. Install Schedule 40 galvanized steel pipe for sleeves smaller than 12 inches in diameter.
 2. Install 0.375 galvanized steel pipe for sleeves 12 inches and larger in diameter.
 3. Modular Mechanical Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble modular mechanical seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- II. New, Poured Concrete, Underground, Exterior-Wall and Slab on Grade Pipe Penetrations: Install water stop sleeves prior to pour. Seal pipe penetrations using modular mechanical seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing modular mechanical seals.
1. Modular Mechanical Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble modular mechanical seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- JJ. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.
1. Seal openings around pipes in sleeves through walls, floors and ceilings, and where floors, fire rated walls and smoke barriers are penetrated. Firestop materials shall be UL listed and shall have a fire rating equal to or greater than the penetrated barrier.
 2. Refer to Division 07 Specification Sections for materials and UL Classified firestop systems.
- KK. Pipe Roof Penetration Enclosures:
1. Coordinate delivery of roof penetration enclosures to jobsite.
 2. Locate and set curbs on roof.
 3. Framing, flashing, and attachment to roof structure are specified under Division 07.
 4. Attach cap to curbs, cut pipe boots to fit pipe, and clamp boots to pipe or conduit.
- LL. Verify final equipment locations for roughing-in.
- MM. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.
- 3.2 PIPING JOINT CONSTRUCTION
- A. Join pipe and fittings according to the following requirements and Division 21, 22, and 23 Sections specifying piping systems.

- B. Cut piping square.
- C. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- D. Remove scale, slag, dirt, oil, and debris from inside and outside of pipe and fittings before assembly.
- E. Clean damaged galvanized surfaces and touch-up with a zinc rich coating.
- F. Use standard long sweep pipe fittings for changes in direction. No mitered joints or field fabricated pipe bends will be permitted. Short radius elbows may be used where specified or specifically authorized by the Architect.
- G. Make tee connections with screwed tee fittings, soldered fittings or specified welded connections. Make welded branch connections with either welding tees or forged branch outlet fittings in accordance with ASTM A234, ANSI B16.9 and ANSI B16.11. For forged branch outlets, furnish forged fittings flared for improved flow where attached to the run, reinforced against external strains and to full pipe-bursting strength requirements. "Fishmouth" connections are not acceptable.
- H. Use eccentric reducers for drainage and venting of pipe lines; bushings are not permitted.
- I. Provide pipe openings using fittings for all systems control devices, thermometers, gauges, etc. Drilling and tapping of pipe wall for connections is prohibited.
- J. Provide temperature sensing device thermal wells and similar piping specialty connections.
- K. Provide instrument connections except thermal wells with specified isolating valves at point of connection to system.
- L. Locate instrument connections in accordance with manufacturer's instructions for accurate read-out of function sensed. Locate instrument connections for easy reading and service of devices.
- M. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."
- N. Brazed Joints: Construct joints according to AWS's "Braze Handbook," "Pipe and Tube" Chapter.
- O. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- P. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

1. Weld-o-lets and thread-o-lets can be used for annular flow measuring devices, temperature control components, and thermal wells. Pipe taps shall be drilled and deburred. Torch cutting is not acceptable.
- Q. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on gaskets and bolt threads.
1. Assemble flanged joints with fresh-stock gasket and hex head nuts, bolts or studs. Make clearance between flange faces such that the connections can be gasketed and bolted tight without strain on the piping system. Align flange faces parallel and bores concentric; center gaskets on the flange faces without projection into the bore.
 2. Lubricate bolts before assembly to insure uniform bolt stressing. Draw up and tighten bolts in staggered sequence to prevent unequal gasket compression and deformation of the flanges. Do not mate a flange with a raised face to a companion flange with a flat face; machine the raised face down to a smooth matching surface and use a full face gasket. After the piping system has been tested and is in service at its maximum temperature, check bolting torque to provide required gasket stress.
- R. Dissimilar-Metal Piping Joints: Construct joints using dielectric fittings compatible with both piping materials. Refer to Application Schedules on the Drawings.
- S. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
 3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
 5. PVC Nonpressure Piping: Join according to ASTM D 2855.
 6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.
- T. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- U. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.
- V. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
1. Plain-End Pipe and Fittings: Use butt fusion.
 2. Plain-End Pipe and Socket Fittings: Use socket fusion.
- W. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.
- X. Remake joints which fail pressure tests with new materials including pipe, fittings, gaskets and/or a filler.

3.3 ACCESS DOORS

- A. Provide access doors for installation by architectural trades. Provide access doors in the walls, as required to make all valves, controls, coils, motors, air vents, filters, electrical boxes, and other equipment installed by the Contractor accessible. Minimum size 12 inches x 12 inches. Provide access doors in the ceiling, for accessibility as mentioned above, 24 inches x 24 inches minimum size. Areas with accessible ceilings (ceilings where lay-in panels are not fastened in place and can be individually removed without removal of adjacent tiles) will not require access doors. Refer to Division 08 Section "Access Doors and Frames" for manufacturers and model numbers and additional information.
- B. When access doors are in fire resistant walls or ceilings, they shall bear the Underwriters' Laboratories, Inc., Label, with time design rating equal to or greater than the wall or ceiling unless they were a part of the tested assembly.

3.4 EQUIPMENT CONNECTIONS

- A. Make connections to equipment, fixtures, and other items included in the work in accordance with the submittals and rough-in measurements furnished by the manufacturers of the particular equipment furnished.
 - 1. Any and all additional connections not shown on the drawings but shown on the equipment manufacturer's submittal or required for the successful operation of the equipment shall be installed as part of this Contract at no additional charge to the Owner.
- B. All piping connections to pumps, coils, and other equipment shall be installed without strain at the pipe connection of this equipment. When directed, remove the bolts in flanged connections or disconnect piping to demonstrate that piping has been so connected.

3.5 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 and smaller, where indicated on Drawings, at final connection to each piece of equipment and at all control valves.
 - 2. Install flanges, in piping NPS 2-1/2 and larger, where indicated on Drawings, at final connection to each piece of equipment and at all control valves.

3.6 INSTALLATION OF PIPE CONCEALMENT SYSTEM

- A. Install cover system, brackets, and cover components for piping according to manufacturer's "Installation Manual."

3.7 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are indicated. Housekeeping pad locations and sizes shall be coordinated by mechanical contractor prior to the placement of concrete slabs.

- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.
- E. For suspended equipment, furnish and install all inserts, rods, structural steel frames, brackets and platforms required. Obtain approval of Architect for same including loads, locations, and methods of attachment.
- F. Equipment Rigging Over Roof Areas: Protect building structure against damage during equipment rigging. Make provisions to distribute load of equipment to main roof structure, and to prevent damage to roof decking, roofing, or purlins.
- G. The Contract Documents indicate items to be purchased and installed. The items are noted by a manufacturer's name, catalog number and/or brief description. The catalog number may not designate all the accessory parts for a particular application. Arrange with the manufacturer for the purchase of all items required for a complete installation.

3.8 PAINTING

- A. Painting of mechanical systems, equipment, and components is specified in Division 09.
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.9 CONCRETE BASES

- A. Concrete housekeeping pads for floor mounted mechanical equipment shall be provided by Architectural Trades.
- B. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions.
 - 1. Construct concrete bases as shown on Drawings or specified, but not less than 4 inches larger in both directions than supported unit.
 - 2. 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 the base.
 - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 - 7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section.

3.10 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
- C. Where pipe and/or equipment support members must be welded to structural building framing, Contractor shall seek prior approval from Architect and structural engineer. Scrape, brush clean, and apply one coat of zinc rich primer after welding.
- D. Field Welding: Comply with AWS D1.1.

3.11 EPOXY BONDING TO EXISTING MATERIALS

- A. Use epoxy bonding compound to set sleeves or pipes in existing concrete to bond new concrete and/or grout to existing materials or to bond dissimilar materials.
- B. The compound, when applied in accordance with the manufacturer's instructions, shall be capable of initial curing within 48 hours at temperatures as low as 40 deg F and shall be capable of bonding any combination of the following properly prepared materials: Wet or dry, cured, or uncured concrete or mortar; vitrified clay; cast iron and carbon steel.

3.12 JACKING OF PIPE

- A. Do not jack pipe in place except upon prior approval of proposed materials and complete details of methods.

3.13 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor mechanical materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

3.14 GROUTING

- A. Mix and install grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.

- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

3.15 CUTTING, CORING AND PATCHING

- A. Refer to Division 01 Specification Sections for requirements for cutting, coring, patching and refinishing work necessary for the installation of mechanical work.
- B. All cutting, coring, patching and repair work shall be performed by the Contractor through approved, qualified subcontractors. Contractor shall include full cost of same in bid.

3.16 EXCAVATION AND BACKFILLING

- A. Refer to Division 31 Specification Sections.
- B. Provide all excavation, trenching, tunneling, and backfilling required for the mechanical work.
- C. Provide all pumping and/or well pointing required for the mechanical work.
- D. Provide foundations if required to support underground piping.
- E. Backfill all excavations with well-tamped granular material. Backfill all excavations under wall footings with lean mix concrete up to underside of footings and extend concrete within excavation a minimum of four (4) feet each side of footing. Granular backfill shall be placed in layers not more than 8 inches in thickness, 95 percent compaction throughout with approved compaction equipment. Tamp, roll as required. Excavated material shall not be used.

3.17 FLASHING

- A. Provide all flashing required for mechanical work. Refer to Division 07 Specification Sections.

3.18 LUBRICATION

- A. Provide all lubrication for the operation of the equipment until acceptance by the Owner. Contractor is responsible for all damage to bearings up to the date of acceptance of the equipment. Protect all bearings and shafts during installation. Thoroughly grease steel shafts to prevent corrosion. Provide covers as required for proper protection of all motors and other equipment during construction.

3.19 FILTERS

- A. Provide and maintain filters in air handling systems throughout the construction period and prior to final acceptance of the building. Do not run air handling equipment, without all prefilters and final filters as specified.

- B. Immediately prior to final building acceptance by the Owner, Contractor shall:
 - 1. Replace all disposable type air filters with new units.

3.20 CLEANING

- A. Each Mechanical Trade shall be responsible for removing all debris daily as required to maintain the work area in a neat, orderly condition.
- B. After equipment, steam, condensate and HVAC water piping systems have been completed and tested, each entire system shall be cleaned and flushed. Refer to Division 23 Section "Piping Systems Flushing and Chemical Cleaning" for requirements. Provide temporary bypass piping and fittings, temporary valves and strainers, temporary water make-up piping with approved means of backflow prevention, and temporary pumps as needed to perform specified flushing and cleaning requirements.
- C. Prior to connection of new HVAC piping to existing HVAC piping systems, all new piping shall be subject to initial flushing, cleaning and final flushing. Refer to Division 23 Section "Piping Systems Flushing and Chemical Cleaning" for requirements. Provide temporary bypass piping and fittings, temporary valves and strainers, temporary water make-up piping with approved means of backflow prevention, and temporary pumps as needed to perform specified flushing and cleaning requirements.
- D. Flushing, cleaning, and disinfection of domestic water piping is specified in Division 22 Section "Domestic Water Piping."
- E. Exterior surfaces of all piping, ductwork and equipment shall be wiped down to remove excess dirt and debris prior to concealment by Architectural Trades work.
- F. Upon completion of work in each respective area, clean and protect work. Just prior to final acceptance, perform additional cleaning as necessary to provide clean equipment and areas to the Owner.

END OF SECTION 200510

SECTION 200513 - MOTORS

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Mechanical Vibration Controls" for mounting motors and vibration isolation devices.
 - 3. Division 20 Section "Variable Frequency Controllers".
 - 4. Division 21, 22, and 23 Sections for application of motors and reference to specific motor requirements for motor-driven equipment.
 - 5. Division 26 Section "Enclosed Switches and Circuit Breakers".
 - 6. Division 26 Section "Enclosed Controllers".
 - 7. Division 26 Section "Fuses".

1.2 SUMMARY

- A. This Section includes basic requirements for factory-installed

1.3 DEFINITIONS

- A. ABMA: American Bearing Manufacturers Association. (Formerly AFBMA: Anti-Friction Bearing Manufacturers Association.)
- B. Factory-Installed Motor: A motor installed by motorized-equipment manufacturer as a component of equipment.
- C. Field-Installed Motor: A motor installed at Project site and not factory installed as an integral component of motorized equipment.
- D. Packaged Self Contained Equipment: Equipment which includes component mechanical and electrical equipment mounted on common bases, skids or frames or in common enclosures with internal control and power wiring factory installed and ready to accept a single electrical service connection. Provide the equipment complete with enclosed controllers, main disconnect switches, control transformers, control devices, wiring and accessories as required.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: A Nationally Recognized Testing Laboratory (NRTL), acceptable to authorities having jurisdiction, with the experience and capability to conduct the testing indicated.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

1.6 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices. Provide motors that are:
 - 1. Compatible with the following:
 - a. Magnetic controllers.
 - b. Multispeed controllers.
 - c. Reduced-voltage controllers.
 - d. Solid-state controllers.
 - e. Variable frequency controllers.
 - 2. Designed and labeled for use with variable frequency controllers, and suitable for use throughout speed range without overheating.
 - 3. Matched to torque and horsepower requirements of the load.
 - 4. Matched to ratings and characteristics of supply circuit and required control sequence.

- B. Coordinate electrical scope of work to be provided by Division 20, 21, 22, and 23 with this Section, related Division 20, 21, 22, and 23 Specifications, Division 26 Specifications and the Drawings.
- C. Electrical work provided under Division 20, 21, 22, and 23: Furnish UL Listed components in accordance with this section, Division 26, and applicable NEMA and NEC (ANSI C 1) requirements. Provide wiring, external to electrical enclosures, in conduit.
- D. Furnished, installed and wired under Division 20, 21, 22, and 23 unless otherwise indicated:
 - 1. Disconnected components in packaged self-contained equipment that are so constructed that components of wiring must be disconnected for shipment and reconnected after installation.
- E. Furnished and installed under Division 20, 21, 22, and 23 and wired under Division 26 unless otherwise indicated:
 - 1. Motors required for mechanical equipment
 - 2. Packaged Self-Contained Equipment:
 - a. Provide equipment ready to accept a single electrical service connection.
 - b. For equipment with remote mounted control panels, provide mounting of the control panel and external wiring from the control panel to the package self-contained equipment.
 - 3. Variable frequency controllers.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fuses: Quantity equal to 10 percent of each fuse type and size, but no fewer than 3 of each type and size.
 - 2. Spare Indicating Lights: Six of each type installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide products by one of the following:
 - 1. Dayton.
 - 2. Toshiba Intl.
 - 3. Baldor Electric/Reliance.
 - 4. Rockwell Automation/Allen-Bradley.
 - 5. Nidec Motor Corporation; U.S. Electrical Motors.
 - 6. Regal Beloit/GE Commercial Motors.
 - 7. Regal Beloit/Leeson.
 - 8. Regal Beloit/Marathon.
 - 9. Siemens.

2.2 MOTOR REQUIREMENTS

- A. Motor requirements apply to factory-installed motors except as follows:
 - 1. Different ratings, performance, or characteristics for a motor are specified in another Section.
 - 2. Manufacturer for a factory-installed motor requires ratings, performance, or characteristics, other than those specified in this Section, to meet performance specified.
 - 3. Submersible motors integral to pumps and excluded from NEMA and EISA standards.
- B. Electrical Power Supply Characteristics: Coordinate electrical system requirements with Division 26.
- C. Electrical Power System Characteristics: As scheduled on the Drawings.
- D. Electrical Connection: Conduit connection boxes, threaded for conduit. For fractional horsepower motors where connection is made directly, provide screwed conduit connection in end frame.

2.3 MOTOR CHARACTERISTICS

- A. Motors 1/2 HP and Larger: Three phase, unless otherwise indicated.
- B. Motors Smaller Than 1/2 HP: Single phase, unless otherwise indicated.
- C. Frequency Rating: 60 Hz.
- D. Voltage Rating: NEMA standard voltage selected to operate on nominal circuit voltage to which motor is connected.
- E. Service Factor: 1.15 for open dripproof motors; 1.0 for totally enclosed motors.
- F. Duty: Continuous duty at ambient temperature of 105 deg F and at altitude of 3300 feet above sea level.
- G. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.
- H. Brake Horsepower Input: Shall not exceed 90 percent of the rated motor horsepower.
- I. Enclosure: Open dripproof (ODP) for motors installed indoors and out of the airstream. Totally-enclosed fan-cooled (TEFC) for motors installed outdoors or within the airstream.

2.4 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Fire pump motors, C-face motors, JP and JM frame motors, and motors over 200 horsepower shall be energy efficient motors. Efficiency of the motor shall

be determined based on the NEMA MG1. The minimum efficiencies, nominal efficiencies and shall meet or exceed Table 12-11.

HP	1800 RPM OPEN DRIP-PROOF MOTORS 4 POLE		1800 RPM ENCLOSED MOTORS 4 POLE	
	NOMINAL	MINIMUM	NOMINAL	MINIMUM
	EFF	EFF	EFF	EFF
1	82.5	81.5	82.5	81.5
1.5	84	82.5	84	82.5
2	84	82.5	84	82.5
3	86.5	85.5	87.5	86.5
5	87.5	86.5	87.5	86.5
7.5	88.5	87.5	89.5	88.5
10	89.5	88.5	89.5	88.5
15	91	90.2	91	90.2
20	91	90.2	91	90.2
25	91.7	91	92.4	91.7
30	92.4	91.7	92.4	91.7
40	93	92.4	93	92.4
50	93	92.4	93	93
60	93.6	93	93.6	93
75	94.1	93.6	94.1	93.6
100	94.1	93.6	94.5	94.1
125	94.5	94.1	94.5	94.1
150	95	94.5	95	94.5
200	95	94.5	95	94.5

HP	1200 RPM OPEN DRIP-PROOF MOTORS 6 POLE		3600 RPM OPEN DRIPPROOF MOTORS 2 POLE	
	NOMINAL	MINIMUM	NOMINAL	MINIMUM
	EFF	EFF	EFF	EFF
1	80	78.5	--	--
1.5	84	82.5	82.5	81.5
2	85.5	84	84	82.5
3	86.5	85.5	84	82.5
5	87.5	86.5	85.5	84
7.5	88.5	87.5	85.5	86.5
10	90.2	89.5	88.5	87.5
15	90.2	89.5	89.5	88.5
20	91	90.2	90.2	89.5
25	91.7	91	91	90.2
30	92.4	91.7	91	90.2
40	93	92.4	91.7	91
50	93	93	92.4	91.7
60	93.6	93	93	92.4
75	93.6	93	93	92.4
100	94.1	93.6	93	92.4
125	94.1	93.6	93.6	93
150	94.5	94.1	93.6	93
200	94.5	94.1	94.5	94.1

- C. Efficiency: Motors 1 horsepower to 200 horsepower shall be premium efficient motors meeting requirements of NEMA Premium Efficiency Motor Program. Efficiency of the motor shall be determined based on the NEMA MG1. The nominal efficiencies shall meet or exceed Table 12-12.

Nominal Efficiencies For "NEMA Premium™" Induction Motors
Rated 600 Volts or Less (Random Wound)

HP	Open Drip-Proof			Totally Enclosed Fan-Cooled		
	6-pole	4-pole	2-pole	6-pole	4-pole	2-pole
1	82.5	85.5	77.0	82.5	85.5	77.0
1.5	86.5	86.5	84.0	87.5	86.5	84.0
2	87.5	86.5	85.5	88.5	86.5	85.5
3	88.5	89.5	85.5	89.5	89.5	86.5
5	89.5	89.5	86.5	89.5	89.5	88.5
7.5	90.2	91.0	88.5	91.0	91.7	89.5
10	91.7	91.7	89.5	91.0	91.7	90.2
15	91.7	93.0	90.2	91.7	92.4	91.0
20	92.4	93.0	91.0	91.7	93.0	91.0
25	93.0	93.6	91.7	93.0	93.6	91.7
30	93.6	94.1	91.7	93.0	93.6	91.7
40	94.1	94.1	92.4	94.1	94.1	92.4
50	94.1	94.5	93.0	94.1	94.5	93.0
60	94.5	95.0	93.6	94.5	95.0	93.6
75	94.5	95.0	93.6	94.5	95.4	93.6
100	95.0	95.4	93.6	95.0	95.4	94.1
125	95.0	95.4	94.1	95.0	95.4	95.0
150	95.4	95.8	94.1	95.8	95.8	95.0
200	95.4	95.8	95.0	95.8	96.2	95.4

Nominal Efficiencies For "NEMA Premium™" Induction Motors
Rated Medium Volts for 5kV or Less (Form Wound)

HP	Open Drip-Proof			Totally Enclosed Fan-Cooled		
	6-pole	4-pole	2-pole	6-pole	4-pole	2-pole
250	95.0	95.0	94.5	95.0	95.0	95.0
300	95.0	95.0	94.5	95.0	95.0	95.0
350	95.0	95.0	94.5	95.0	95.0	95.0
400	95.0	95.0	94.5	95.0	95.0	95.0
450	95.0	95.0	94.5	95.0	95.0	95.0
500	95.0	95.0	94.5	95.0	95.0	95.0

- D. Stator: Copper windings, unless otherwise indicated.
1. Multispeed motors shall have separate winding for each speed.
- E. Rotor: Squirrel cage, unless otherwise indicated.
- F. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum ABMA 9, L-10 life of 120,000 hours. Calculate bearing load with NEMA minimum V- belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.
- G. Temperature Rise: Match insulation rating, unless otherwise indicated.
- H. Insulation: Class F, unless otherwise indicated.

- I. Code Letter Designation:
 - 1. Motors 10 HP and Larger: NEMA starting Code (KVA Code) F or G.
 - 2. Motors Smaller Than 10 HP: Manufacturer's standard starting characteristic.
 - 3. Fire Pump Motors: NEMA starting Code (KVA Code) B.
- J. Enclosure: Cast iron for motors 7.5 hp and larger; rolled steel for motors smaller than 7.5 hp.
 - 1. Finish: Gray enamel.
- K. Sound Level: Not to exceed NEMA MG-1 12.54.

2.5 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Reduced-Inrush Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
 - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
 - 2. Premium-Efficient Motors: Class B temperature rise; Class F insulation.
- C. Shaft Grounding: Provide a means to protect motor from common mode currents.
 - 1. Required for:
 - a. Motors used with variable frequency controllers.
 - b. Motors 100 HP and larger.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Electro Static Technology, Inc.; Aegis SGR Conductive Microfiber.
- D. Severe-Duty Motors: Totally enclosed, with 1.25 minimum service factor, greased bearings, integral condensate drains, and capped relief vents. Windings insulated with nonhygroscopic material.
 - 1. Finish: Chemical-resistant paint over corrosion-resistant primer.
- E. Source Quality Control: Perform the following tests on each motor according to NEMA MG 1:
 - 1. Measure winding resistance.
 - 2. Read no-load current and speed at rated voltage and frequency.
 - 3. Measure locked rotor current at rated frequency.
 - 4. Perform high-potential test.

2.6 ELECTRONICALLY COMMUTATED MOTOR (ECM)

- A. Furnish for equipment where specified or scheduled with ECM.
 - 1. Synchronous, constant torque, ECM with permanent magnet rotor. Rotor magnets to be time-stable, nontoxic ceramic magnets (Sr-Fe).
 - 2. Driven by a frequency converter with an integrated power factor correction filter. Conventional induction motors will not be acceptable.
 - 3. Each motor with an integrated variable-frequency drive, tested as one unit by manufacturer.
 - 4. Motor speed adjustable over full range from 0 rpm to maximum scheduled speed.
 - 5. Variable motor speed to be controlled by a 0- to 10 V-dc or 4- to 20-mA input.
 - 6. Integrated motor protection verified by UL to protect equipment against over-/undervoltage, overtemperature of motor, electronics, or both, overcurrent, locked rotor, and dry run (no-load condition).

2.7 SINGLE-PHASE MOTORS

- A. Type: One of the following, to suit starting torque and requirements of specific motor application:
 - 1. Permanent-split capacitor.
 - 2. Split-phase start, capacitor run.
 - 3. Capacitor start, capacitor run.
- B. Shaded-Pole Motors: For motors 1/20 hp and smaller only.
- C. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.
- D. Bearings: Ball type for belt-connected motors and other motors with high radial forces on motor shaft; sealed, prelubricated-sleeve type for other single-phase motors.

2.8 ENCLOSED CONTROLLERS

- A. Provide enclosed controllers in accordance with requirements specified in Division 26 Section "Enclosed Controllers".

2.9 ENCLOSED SWITCHES AND CIRCUIT BREAKERS

- A. Provide enclosed switches and circuit breakers in accordance with requirements specified in Division 26 Section "Enclosed Switches and Circuit Breakers".

2.10 FUSES

- A. Provide fuses in accordance with requirements specified in Division 26 Section "Fuses".

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

- A. All three phase motors 1/2 HP and above shall be tested by the Testing Agency.
- B. Prepare for acceptance tests as follows:
 - 1. Check motor nameplates for horsepower, speed, phase and voltage.
 - 2. Check coupling alignment and shaft end play.
 - 3. Run each motor with its controller. Demonstrate correct rotation, alignment, and speed at motor design load.
 - 4. Test interlocks and control features for proper operation.
 - 5. Verify that current in each phase is within nameplate rating.
- C. Testing: Owner will engage a qualified testing agency to perform the following field quality-control testing:
- D. Testing: Engage a qualified testing agency to perform the following field quality-control testing:
- E. Testing: Perform the following field quality-control testing:
 - 1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.15.1. Certify compliance with test parameters.
 - 2. Jog motor as required to verify proper phase and shaft rotation. Immediately after start-up, check bearing temperature and smooth operation. Take current reading at full load using a clamp-on ammeter. If ammeter reading is over the rated full load current, determine reason for discrepancy and take necessary corrective actions. Record all readings, motor nameplate data and overload heater data.
 - 3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.2 ADJUSTING

- A. Align motors, bases, shafts, pulleys and belts. Tension belts according to manufacturer's written instructions.

3.3 CLEANING

- A. After completing equipment installation, inspect unit components. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.
- B. Clean motors, on completion of installation, according to manufacturer's written instructions.

END OF SECTION 200513

SECTION 200516 - PIPE FLEXIBLE CONNECTORS, EXPANSION FITTINGS AND LOOPS

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."
 - 3. Division 23 Section "Refrigerant Piping."

1.2 DEFINITIONS

- A. BR: Butyl rubber.
- B. CR: Chlorosulfonated polyethylene synthetic rubber (Neoprene).
- C. CSM: Chlorosulfonyl-polyethylene rubber (Hypalon).
- D. EPDM: Ethylene-propylene-diene terpolymer rubber.
- E. NBR: Buna-N/Nitrile rubber.
- F. NR: Natural rubber.
- G. PTFE: Polytetrafluoroethylene plastic.

1.3 PERFORMANCE REQUIREMENTS

- A. Compatibility: Products shall be suitable for piping system fluids, materials, working pressures, and temperatures.

- B. Capability: Products shall absorb 150 percent of maximum axial movement between anchors.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of pipe flexible connector, expansion joint and alignment guide indicated.

1.5 INFORMATIONAL SUBMITTALS

- A. Delegated-Design Submittal:
 - 1. Design calculations and detailed fabrication and assembly of pipe anchors and alignment guides for multiple pipes, expansion joints and loops, and attachments of the same to the building structure.
 - 2. Locations of pipe anchors and alignment guides and expansion joints and loops.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer.
 - 1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and bends.
 - 2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
 - 3. Alignment Guide Details: Detail field assembly and attachment to building structure.
 - 4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.
- C. Product Certificates: For each type of pipe expansion joint, signed by product manufacturer.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For pipe expansion joints to include in operation and maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of Lead in Drinking Water Act," about lead content in materials that will be in contact with potable water for human consumption.
- B. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," and NSF 372 Drinking Water System Components - Lead Content for potable domestic water piping and components.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 FLEXIBLE CONNECTORS

- A. Hose and Braid Flexible Connectors:

1. Manufacturers:
 - a. Adscos Manufacturing, LLC.
 - b. Flex-Hose Co., Inc.
 - c. Flex-Weld, Inc.
 - d. Hyspan Precision Products, Inc.
 - e. Metraflex, Inc.
 - f. Senior Flexonics, Inc.; Pathway Division.
 - g. Twin City Hose, Inc.
2. Flexible Connectors for Copper Piping: Multiple-ply phosphor-bronze corrugated hose with bronze outer braid, copper ferrule, and copper pipe end connections.
3. Flexible Connectors for Steel Piping: Multiple-ply stainless-steel corrugated hose with stainless steel outer braid, and steel pipe end connections.
4. Minimum Pressure Rating: 150 psig, unless otherwise indicated.
5. Maximum Temperature Rating: 450 deg F for copper piping connectors, 800 deg F for steel piping connectors.

PART 3 - EXECUTION

3.1 FLEXIBLE CONNECTOR APPLICATIONS

- A. Use hose and braid flexible pipe connectors at the inlet and outlet water connections of base mounted pumps, chillers, and cooling towers, unless otherwise indicated.
1. Flexible Connectors: Stainless steel hose and braid style with threaded end connections for pipe sized NPS 2 and smaller.
 2. Flexible Connectors: Stainless steel hose and braid style with steel flange end connections for pipe sized NPS 2-1/2 and larger.
- B. Flexible Pipe Connectors for Refrigerant Pipe: Refer to Division 23 Section "Refrigerant Piping."

END OF SECTION 200516

SECTION 200519 - METERS AND GAGES

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."
 - 3. Division 21 Section "Fire-Suppression Piping" for listed or approved pressure gages.
 - 4. Division 21 fire pump sections for fire-pump flowmeter systems.
 - 5. Division 22 Section "Domestic Water Piping" for domestic and fire-protection water service meters inside the building.
 - 6. Division 23 Section "Steam and Condensate Piping" for steam and condensate meters.
 - 7. Division 23 Section "Fuel Gas Piping" for gas utility meters.

1.2 DEFINITIONS

- A. CR: Chlorosulfonated polyethylene synthetic rubber.
- B. EPDM: Ethylene-propylene-diene terpolymer rubber.
- C. FPR: Fiberglass reinforced plastic.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated; include performance curves.

1.4 INFORMATIONAL SUBMITTALS

- A. Shop Drawings: Schedule for the following indicating manufacturer's number, scale range, and location for each:
 - 1. Thermometers.
 - 2. Gages.
 - 3. Flowmeters.
 - 4. Thermal-energy meters.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For the following to include in operation and maintenance manuals:
 - 1. Flowmeters.
 - 2. Thermal-energy meters.

1.6 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of Lead in Drinking Water Act," about lead content in materials that will be in contact with potable water for human consumption.
- B. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," and NSF 372 Drinking Water System Components - Lead Content for potable domestic water piping and components.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 METAL-CASE, LIQUID-IN-GLASS THERMOMETERS

- A. Manufacturers:
 - 1. AMETEK, Inc.; U.S. Gauge Div.
 - 2. Miljoco Corporation.
 - 3. REOTEMP Instrument Corporation.
 - 4. Terrice, H. O. Co.
 - 5. Weiss Instruments, Inc.

6. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
- B. Case: Die-cast aluminum or Chrome-plated brass, 9 inches long.
- C. Tube: Red, blue, or green reading, organic-liquid filled, with magnifying lens.
- D. Tube Background: Satin-faced, nonreflective aluminum with permanent scale markings.
- E. Window: Glass or plastic.
- F. Connector: Adjustable type, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device.
- G. Stem: Copper-plated steel, aluminum, or brass for thermowell installation and of length to suit installation.
- H. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.3 THERMOWELLS

- A. Manufacturers: Same as manufacturer of thermometer being used.
- B. Description: Pressure-tight, socket-type metal fitting made for insertion into piping and of type, diameter, and length required to hold thermometer. Brass for compatible services less than 353 degrees F; ANSI 18-8 stainless steel for all others to suit service. Furnish extension neck to accommodate insulation where applicable.

2.4 PRESSURE GAGES

- A. Manufacturers:
 1. AMETEK, Inc.; U.S. Gauge Div.
 2. Cambridge.
 3. Dwyer Instruments, Inc.
 4. Marsh Bellofram.
 5. Miljoco Corporation.
 6. Trerice, H. O. Co.
 7. Weiss Instruments, Inc.
 8. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
- B. Direct-Mounting, Dial-Type Pressure Gages: Indicating-dial type complying with ASME B40.100.
 1. Case: Stainless steel, aluminum, or FRP, 6-inch diameter.
 2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
 3. Pressure Connection: Brass, NPS 1/4, bottom-outlet type unless back-outlet type is indicated.
 4. Movement: Mechanical, with link to pressure element and connection to pointer.
 5. Dial: Satin-faced, nonreflective aluminum with permanent scale markings.
 6. Pointer: Red or other dark-color metal.
 7. Window: Glass or plastic.
 8. Ring: Stainless steel or chrome plated metal.

- C. Accuracy: Grade A, plus or minus 1 percent of middle half scale.
 - 1. Vacuum-Pressure Range: 30-in. Hg of vacuum to 15 psig of pressure.
 - 2. Water: 0-100 PSIG (1 psi divisions to 50 psi; 5 psi divisions above 50 psi), liquid filled.
 - 3. Steam (15 psig and less): 30 inches Hg vacuum-30 PSIG (1 inch divisions below 0 psi; 1 psi divisions above 0 psi), silicone dampened.
 - 4. Steam (16 to 60 psig): 30 inches Hg vacuum-100 PSIG, silicone dampened.
 - 5. Range for Fluids under Pressure: 1-1/2 times expected working pressure. If not a standard scale, select next largest scale.

- D. Pressure-Gage Fittings:
 - 1. Valves: NPS 1/4 brass ball type.
 - 2. Syphons: NPS 1/4 coil of brass tubing with threaded ends.
 - 3. Snubbers: ASME B40.5, NPS 1/4 brass bushing with corrosion-resistant, porous-metal disc of material suitable for system fluid and working pressure.

2.5 TEST PLUGS

- A. Manufacturers:
 - 1. Peterson Equipment Co., Inc.
 - 2. Miljoco Corporation.

- B. Description: Corrosion-resistant brass or stainless-steel body with core inserts and gasketed and threaded cap, with extended stem for units to be installed in insulated piping.

- C. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F for cold services, and 500 psig at 275 deg F for hot services.

- D. Core Inserts: One or two self-sealing rubber valves.
 - 1. Insert material for air, water, oil, or gas service at 20 to 200 deg F shall be Neoprene.
 - 2. Insert material for air or water service at minus 30 to plus 275 deg F shall be Nordel.

2.6 PITOT-TUBE FLOWMETERS

- A. Manufacturers:
 - 1. Dieterich Standard; Subsidiary of Rosemount Division of Emerson Process Management.
 - 2. Preso Meters Corporation.
 - 3. Taco, Inc.
 - 4. World Class Engineered Products, Inc.; PSE Division.

- B. Description: Insertion-type, differential-pressure design for inserting probe into piping and measuring flow directly in gallons per minute.

- C. Construction: Stainless-steel probe of length to span inside of pipe; with integral transmitter and direct-reading scale.

- D. Pressure Rating: 150 psig minimum.
- E. Temperature Rating: 250 deg F minimum.
- F. Display: Visual instantaneous rate of flow, with register to indicate total volume in gallons.
- G. Integral Transformer: For low-voltage power connection.
- H. Accuracy: Plus or minus 1 percent for liquids and gases.

PART 3 - EXECUTION

3.1 THERMOMETER APPLICATIONS

- A. Install liquid-in-glass thermometers in the following locations:
 - 1. Inlet and outlet of each hydronic zone.
 - 2. Inlet and outlet of each hydronic boiler and chiller.
 - 3. Inlet and outlet of each hydronic coil in air-handling units and built-up central systems.
 - 4. Inlet and outlet of each hydronic heat exchanger.
 - 5. Inlet and outlet of each hydronic heat-recovery unit.
 - 6. Inlet and outlet of each thermal storage tank.
 - 7. Outside-air, return-air, and mixed-air ducts.
- B. Provide the following temperature ranges for thermometers:
 - 1. Domestic Hot Water: 30 to 180 deg F, with 2-degree scale divisions.
 - 2. Domestic Cold Water: 30 to 130 deg F, with 2-degree scale divisions.
 - 3. Heating Hot Water: 30 to 240 deg F, with 2-degree scale divisions.
 - 4. Chilled Water: 0 to 100 deg F, with 2-degree scale divisions.

3.2 GAGE APPLICATIONS

- A. Install dry-case-type pressure gages on inlet and outlet of each pressure-reducing valve.
- B. Install liquid-filled-case-type pressure gages at chilled- and condenser-water inlets and outlets of chillers.
- C. Install liquid-filled-case-type pressure gages at suction and discharge of each pump.

3.3 INSTALLATIONS

- A. Install direct-mounting thermometers and adjust vertical and tilted positions.
- B. Install thermowells with socket extending to center of pipe and in vertical position in piping tees where thermometers are indicated.

- C. Duct Thermometer Support Flanges: Install in wall of duct where duct thermometers are indicated. Attach to duct with screws.
- D. Install direct-mounting pressure gages in piping tees with pressure gage located on pipe at most readable position.
- E. Install ball valve and snubber fitting in piping for each pressure gage for fluids (except steam).
- F. Install ball valve and syphon fitting in piping for each pressure gage for steam.
- G. Install test plugs in tees in piping.
- H. Install flow indicators, in accessible positions for easy viewing, in piping systems.
- I. Assemble and install connections, tubing, and accessories between flow-measuring elements and flowmeters as prescribed by manufacturer's written instructions.
- J. Install flowmeter elements in accessible positions in piping systems.
- K. Install differential-pressure-type flowmeter elements with at least minimum straight lengths of pipe upstream and downstream from element as prescribed by manufacturer's written instructions.
- L. Install wafer-orifice flowmeter elements between pipe flanges.
- M. Install permanent indicators on walls or brackets in accessible and readable positions.
- N. Install connection fittings for attachment to portable indicators in accessible locations.
- O. Install flowmeters at discharge of hydronic system pumps and at inlet of hydronic air coils.
- P. Assemble components and install thermal-energy meters.
- Q. Mount meters on wall if accessible; if not, provide brackets to support meters.

3.4 CONNECTIONS

- A. Install meters and gages adjacent to machines and equipment to allow service and maintenance for meters, gages, machines, and equipment.
- B. Connect flowmeter-system elements to meters.
- C. Connect flowmeter transmitters to meters.
- D. Connect thermal-energy-meter transmitters to meters.
- E. Ground equipment according to Division 26 Section "Grounding and Bonding."
- F. Connect wiring according to Division 26 Section "Conductors and Cables."

3.5 ADJUSTING

- A. Calibrate meters according to manufacturer's written instructions, after installation.
- B. Adjust faces of meters and gages to proper angle for best visibility.

END OF SECTION 200519

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
 - 2. Division 20 Section "Mechanical General Requirements."
 - 3. Division 20 Section "Basic Mechanical Materials and Methods."
 - 4. Division 20 Section "Mechanical Vibration Controls" for vibration isolation devices.
 - 5. Division 20 Section "Pipe Flexible Connectors, Expansion Fittings and Loops" for pipe guides and anchors.
 - 6. Division 21 Section "Fire-Suppression System" for pipe hangers for fire-protection piping.
 - 7. Division 23 Section(s) "Metal Ducts for duct hangers and support.

1.2 DEFINITIONS

- A. MSS: Manufacturers Standardization Society for the Valve and Fittings Industry Inc.
- B. MFMA: Metal Framing Manufacturers Association.

1.3 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.4 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel pipe hangers and supports.
 - 2. Thermal-hanger shield inserts.

1.5 INFORMATIONAL SUBMITTALS

- A. Shop Drawings: Show fabrication and installation details and include calculations for the following:
 - 1. Trapeze pipe hangers. Include Product Data for components.
 - 2. Metal framing systems. Include Product Data for components.
 - 3. Pipe stands. Include Product Data for components.
 - 4. Equipment supports.

1.6 QUALITY ASSURANCE

- A. MSS Standards: Pipe hangers, supports, and accessories shall comply with the following:
 - 1. MSS SP-58, Pipe Hangers and Supports – Materials, Design and Manufacture, Selection, Application, and Installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 HANGER ROD MATERIAL

- A. Threaded, hot rolled, steel rod conforming to ASTM A 36 or A575.
 - 1. Rod continuously threaded.
 - 2. Use of rod couplings is prohibited.

2.3 STEEL PIPE HANGERS AND SUPPORTS

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article, and schedules and details on the Drawings for where to use specific hanger and support types.
 - 1. Hangers and Supports for Fire Protection Piping: UL listed or FMG approved.
- B. Manufacturers:
 - 1. Anvil; ASC Engineered Solutions.
 - 2. B-Line by Eaton.
 - 3. Carpenter & Paterson, Inc.
 - 4. Hilti USA.
 - 5. nVent Electric plc; CADDY.
 - 6. PHD Manufacturing, Inc.
- C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.
- E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.4 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.5 METAL FRAMING SYSTEMS

- A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.
- B. Manufacturers:
 - 1. Anvil; Anvil-Strut; ASC Engineered Solutions.
 - 2. B-Line by Eaton.
 - 3. nVent Electrical plc; ERISTRUT Div.
 - 4. Power-Strut; a part of Atkore International.
 - 5. Unistrut; a part of Atkore International.
 - 6. Hilti USA.
- C. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.
- D. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.

- E. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.6 METAL INSULATION SHIELDS

A. Manufacturers:

1. Anvil; ASC Engineered Solutions.
2. B-Line by Eaton.
3. Carpenter & Paterson, Inc.
4. nVent Electric plc; CADDY.
5. PHD Manufacturing, Inc.

- B. Description: MSS SP-58, Type 40, protective shields. Shields shall span an arc of 180 degrees.

C. Shield Dimensions for Pipe: Not less than the following:

1. NPS 1/4 to NPS 2: 12 inches long and 0.048 inch thick.

2.7 PIPE COVERING PROTECTION SADDLES

A. Manufacturers:

1. Anvil; ASC Engineered Solutions.
2. B-Line by Eaton.
3. Carpenter & Paterson, Inc.
4. nVent Electric plc; CADDY.
5. PHD Manufacturing, Inc.

- B. Description: MSS SP-58, Type 39A and Type 39B, for suspension of insulated hot pipe where heat losses are to be kept to a minimum.

1. Saddles shall match insulation thickness.
2. Saddle length: 12 inches.
3. Furnish with center rib for pipe sized NPS 12 and larger.

2.8 PLASTIC INSULATION SHIELDS

A. Manufacturers:

1. Anvil; ASC Engineered Solutions.
2. Armacell LLC; Insuguard.
3. B-Line by Eaton; Snap'N Shield.
4. Hydra-Zorb Company; Bronco.

- B. Description: Polypropylene copolymer protective shields with modular elements designed to snap directly onto strut channel, clevis hangers, or structural members. Shields shall span an arc of 180 degrees.

1. Operating Temperature Range: Minus 40 deg F to plus 178 deg F .

C. Certifications:

1. UL Classified for USA: UL-723 (ASTM E 84).

2. UL listed for Canada: ULC-S102.2.
3. Meets UL94 HB flammability standards.

D. Shield Dimensions for Pipe: Not less than the following:

1. NPS 1/4 to NPS 4: 12 inches long.

2.9 THERMAL-HANGER SHIELDS

A. Manufacturers:

1. American Mechanical Insulation Sales Inc. (AMIS).
2. B-Line by Eaton.
3. nVent Electric plc; CADDY.
4. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
5. Rilco Manufacturing Company, Inc.
6. Value Engineered Products, Inc.

B. Description: Manufactured assembly consisting of insulation insert encased in 360 degree sheet metal shield.

1. Minimum Compressive Strength of Insert Material:

- a. 100-psig- for sizes smaller than NPS 6.
- b. 600-psig- for sizes NPS 6 and larger.

C. Insulation-Insert Material for Cold Piping: Full 360 degree, water-repellent treated, ASTM C 533, Type I calcium silicate with vapor barrier.

D. Insulation-Insert Material for Hot Piping: Full 360 degree, water-repellent treated, ASTM C 533, Type I calcium silicate.

E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

F. Include carbon steel ASTM A36 load distribution plates as required by load, pipe movement, hanger style, and hanger spacing.

G. Thermal-Hanger Shields for Flexible Foamed Elastomeric Insulated Piping:

1. Manufacturer:

- a. B-Line by Eaton/Armacell; Armafix IPH.
- b. Aeroflex USA, Inc.; Aerofix-U.
- c. ZSi-Foster, Inc.; Cush-A-Therm.

2. Insulation-Insert Material for Copper Piping with Flexible Foamed Elastomeric Insulation: Use the following:

- a. Flexible foamed elastomeric, ASTM 534, Type I-Tubular Grade 1 with PUR/PIP support inserts.

H. Thermal-Hanger Shields for Small Diameter Piping:

1. Manufacturer:

- a. Hydra-Zorb Company; Klo-Shure Insulation Couplings.
2. Insulation-Insert Material for Small Diameter Piping with Flexible Foamed Elastomeric or Glass Fiber Insulation: Use the following:
 - a. Rigid Hytrel thermoplastic insulation coupling designed for use with pipe or tube NPS 4 and smaller, and insulation from 3/8 inch to 1-1/2 inch thick.

2.10 FASTENER SYSTEMS

A. Post-Installed Anchors:

1. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - a. Manufacturers:
 - 1) B-Line by Eaton.
 - 2) DeWalt Engineered by Powers.
 - 3) Hilti, Inc.
 - 4) ITW Ramset/Red Head.
 - 5) MKT Fastening, LLC.
 2. Internally Threaded Screw Anchors: Internally threaded, self-tapping screw anchor designed for performance in cracked and uncracked concrete. Suitable base materials include normal-weight concrete, sand-lightweight concrete and concrete over steel deck.
 - a. UL Listed or FMG approved for fire sprinkler piping.
 - b. Available Sizes: For 1/4-inch, 3/8-inch, and 1/2-inch diameter rod sizes
 - c. Manufacturers:
 - 1) B-Line by Eaton; Rapid Rod Hangers.
 - 2) DeWalt Engineered by Powers; Snake+.

2.11 ROOF MOUNTED PIPING SUPPORTS

- A. Pipe Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Low, Fixed-Height, Single-Base Stand: Assembly of base and horizontal member, and pipe support, for roof installation without membrane penetration.
 1. Manufacturers:
 - a. B-Line by Eaton; Dura-Blok.
 - b. Eco Support Products.
 - c. MIFAB, Inc.; C-Port.
 - d. MIRO Industries; Conduit and Condensate Supports, and Rooftop Sleeper Support.
 - e. nVent Electric plc; CADDY.
 - f. Portable Pipe Hangers.
 2. Base: Plastic, stainless steel, or recycled rubber.

3. Horizontal Member: Cadmium-plated-steel or galvanized-steel strut designed for use with standard strut clamps and accessories.
- C. Low, Adjustable-Height, Single-Base Stand: Assembly of base, horizontal member, and adjustable vertical members, and pipe support, for roof installation without membrane penetration.
1. Manufacturers:
 - a. B-Line by Eaton; Dura-Blok.
 - b. Eco Support Products.
 - c. MIFAB, Inc.; C-Port.
 - d. MIRO Industries; Conduit and Condensate Supports.
 - e. nVent Electric plc; CADDY.
 - f. Portable Pipe Hangers.
 2. Base: Plastic, stainless steel, or recycled rubber.
 3. Horizontal Member: Cadmium-plated-steel or galvanized-steel strut designed for use with standard strut clamps and accessories.
 4. Vertical Members: Threaded, hot rolled, steel rod conforming to ASTM A 36 or A575 with cadmium plated nuts and washers. Rod continuously threaded.
- D. High, Adjustable-Height, Single-Base Stand: Assembly of base, horizontal member, and adjustable vertical members, and clevis type pipe support, for roof installation without membrane penetration.
1. Manufacturers:
 - a. B-Line by Eaton; Dura-Blok.
 - b. Eco Support Products.
 - c. MIFAB, Inc.; C-Port.
 - d. MIRO Industries; Water and Steam Supports.
 - e. nVent Electric plc; CADDY.
 - f. Portable Pipe Hangers.
 2. Base: Plastic, stainless steel, or recycled rubber.
 3. Horizontal Member: Cadmium-plated-steel or galvanized-steel strut designed for use with standard strut clamps and accessories.
 4. Vertical Members: Threaded, hot rolled, steel rod conforming to ASTM A 36 or A575 with cadmium plated nuts and washers. Rod continuously threaded.
- E. Low, Fixed-Height, Single-Base Roller Stand: Assembly of base and horizontal roller, for roof installation without membrane penetration.
1. Manufacturers:
 - a. B-Line by Eaton; Dura-Blok.
 - b. Eco Support Products.
 - c. MIFAB, Inc.; C-Port.
 - d. MIRO Industries; Gas and Mechanical Supports.
 - e. nVent Electric plc; CADDY.
 - f. Portable Pipe Hangers.
 2. Base: Plastic, stainless steel, or recycled rubber.
 3. Horizontal Member: Cadmium-plated-steel rod and corrosion resistant roller designed for use with standard accessories.

- F. Low, Adjustable-Height, Single-Base Roller Stand: Assembly of base and horizontal roller, for roof installation without membrane penetration.
1. Manufacturers:
 - a. B-Line by Eaton; Dura-Blok.
 - b. Eco Support Products.
 - c. MIFAB, Inc.; C-Port.
 - d. MIRO Industries; Gas and Mechanical Supports.
 - e. nVent Electric plc; CADDY.
 - f. Portable Pipe Hangers.
 2. Base: Plastic, stainless steel, or recycled rubber.
 3. Horizontal Member: Cadmium-plated-steel rod and corrosion resistant roller designed for use with standard accessories.
 4. Vertical Members: Threaded, hot rolled, steel rod conforming to ASTM A 36 or A575 with cadmium plated nuts and washers. Rod continuously threaded.
- G. High, Multiple-Base Pipe Stand: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
1. Manufacturer:
 - a. B-Line by Eaton; Dura-Blok.
 - b. Eco Support Products.
 - c. MIFAB, Inc.; C-Port.
 - d. MIRO Industries; Water and Steam Supports.
 - e. nVent Electric plc; CADDY.
 - f. Portable Pipe Hangers.
 2. Bases: Two or more plastic, steel, or recycled rubber.
 3. Vertical Members: Two or more protective-coated-steel channels.
 4. Horizontal Member: Protective-coated-steel channel.
 5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.
- H. Custom, Multiple-Base Pipe Stand: Assembly of bases, vertical and horizontal members, and pipe supports or rollers, for roof installation without membrane penetration.
1. Manufacturer:
 - a. B-Line by Eaton; Dura-Blok.
 - b. Eco Support Products.
 - c. MIFAB, Inc.; C-Port.
 - d. MIRO Industries; Custom Design Products.
 - e. nVent Electric plc; CADDY.
 - f. Portable Pipe Hangers.
 2. Bases: Four or more plastic, steel, or recycled rubber.
 3. Vertical Members: Two or more protective-coated-steel channels.
 4. Horizontal Member: Protective-coated-steel channel.
 5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.
 6. Pipe Rollers: Cadmium-plated-steel rod and corrosion resistant roller designed for use with standard accessories.
- I. Curb-Mounting Pipe Stands: Shop- or field-fabricated pipe support made from structural-steel shape, continuous-thread rods, and rollers for mounting on permanent stationary roof curb.

1. Roof Curb Type Supports: Coordinate installation and type with Architectural Trades. Top shall be level and extend a minimum of 10 inches above top of roof insulation.
 - a. Manufacturers:
 - 1) Pate.
 - 2) Thybar; Thycurb.
 - 3) Roof Products and Systems.
 - 4) Greenheck.
 - 5) Creative Metals.

2.12 ROOF MOUNTED EQUIPMENT SUPPORTS

- A. Equipment Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted equipment.
- B. Non-Penetrating Equipment Supports: Assembly of two or more bases and horizontal members, for roof installation without membrane penetration.
 1. Manufacturers:
 - a. B-Line by Eaton; Dura-Blok.
 - b. Eco Support Products.
 - c. MIFAB, Inc.; C-Port.
 - d. MIRO Industries; HD and LD Mechanical Unit Supports.
 - e. nVent Electric plc; CADDY.
 - f. Portable Pipe Hangers.
 2. Base: Plastic, stainless steel, or recycled rubber.
 3. Horizontal Member: Cadmium-plated-steel, galvanized-steel, or stainless steel strut, and planking; designed for use with standard strut clamps, all-thread rod, and accessories.
- C. Roof Rail-Type Equipment Stands: Welded 18 gage galvanized steel shell, base plate and counter flashing. Factory installed chemically treated wood nailer. Fully mitered end sections. Internal bulkhead reinforcement.
 1. Roof Rail Type Supports: Coordinate installation and type with Architectural Trades. Top shall be level and extend a minimum of 10 inches above top of roof insulation.
 - a. Manufacturers:
 - 1) Pate.
 - 2) Thybar; TEMS Series.
 - 3) Roof Products and Systems.
 - 4) Greenheck.
 - 5) Creative Metals.

2.13 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.14 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

- A. Refer to application schedules on the Drawings.
- B. For insulated pipe, oversize hanger elements to accommodate insulation thickness.
- C. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
- D. Comply with MSS SP-58 for pipe hanger selections and applications that are not specified in piping system Sections.
- E. Use hangers and supports with galvanized, metallic coatings for outdoor applications or where exposed to outdoor conditions.
- F. Use hangers and supports with plastic coating, or galvanized metallic coatings for applications in corrosive atmospheres.
- G. Use metal framing, with plastic coating, or galvanized metallic coatings for metal framing in corrosive atmospheres.
- H. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- I. Use padded hangers for piping that is subject to scratching.
- J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. MSS Type 8 or spring type to meet system requirements.
- K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 - 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
 - 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 - 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 - 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

- L. Concrete Structure Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Anchor Devices, Concrete and Masonry: in accordance with Group I, Group II, Type 2, Class 2, Style 1 and Style 2, Group III and Group VIII or FS FF-S-325A. Furnish cast-in floor type equipment anchor devices with adjustable positions. Furnish built in anchor devices for masonry, unless otherwise approved by the Architect. Powder actuated anchoring devices shall not be used to support any mechanical systems components.
 - 2. Inserts, Concrete: TYPE 18 or 19. When applied to loads equivalent to piping in sizes NPS 2 and larger, and where otherwise required by imposed loads, a one foot length of 1/2 inch reinforcing rod shall be inserted and wired through wing slots. Proprietary type continuous inserts may be proposed and shall be submitted for approval.
 - 3. Use mechanical-expansion anchors where required in concrete construction.
 - 4. Use chemical fasteners where required in concrete construction.

 - M. Steel Frame Structure Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Beam Clamps:
 - a. Center Loading: TYPE 21, 28, 29 and 30, unless otherwise indicated. Type 27 shall be allowed to support single pipes NPS 6 size or smaller only.
 - b. "C" Clamps: Type 19, 20 or 23, for supporting single pipes NPS 2-1/2 size or smaller only. Use of "C" clamps, or beam clamps of "C" pattern, or any modification thereof, is prohibited for supporting multiple pipes or pipes larger than NPS 2-1/2.

 - N. Hanger-Rod Attachments for Wood Construction: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. All Steel Ceiling Plates: UL listed and suitable for attachment to wood beams. For pipe sizes NPS 1/2 to NPS 2. Install in accordance with manufacturer's instructions to maintain listing.
 - 2. Threaded Side Beam Brackets: UL listed and FMG approved, suitable for attachment to wood beams. For pipe sizes NPS 2 to NPS 4. Install in accordance with manufacturer's instructions to maintain listing.

 - O. Comply with MSS SP-58 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.

 - P. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
- 3.2 HANGER AND SUPPORT INSTALLATION
- A. Steel Pipe Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from building structural frame.

 - B. Provide necessary piping and equipment supporting elements including: building structure attachments, supplementary steel, hanger rods, stanchions and fixtures, vertical pipe attachments, horizontal pipe attachments, anchors, guides, spring supports in accordance with the referenced codes, standards, and requirements specified. Support piping and equipment from building structure, not from roof deck, floor slab, other pipe, duct or equipment.

- C. At connections between piping systems, hangers and equipment of dissimilar metals, insulate, using dielectric insulating material, nonferrous piping against direct contact with the building steel by insulating the contact point of the hanger and pipe or the hanger and building steel. Test each point of dielectric insulation with an ohm meter to ensure proper isolation of dissimilar materials. Test shall be observed by the Owner's Representative and/or Architect.
- D. Use copper plated or plastic coated supporting element in contact with copper tubing or glass piping.
- E. File and paint cut ends and shop or field prime paint supporting element components.
- F. Secure Type 40 shields to support elements in a manner that prevents movement and damage to insulation and jacket materials.
- G. Hang piping parallel with the lines of the building, unless otherwise indicated. Route piping in an orderly manner and maintain gradient. Space piping and components so a threaded pipe fitting may be removed between adjacent pipes and so there will be not less than 1/2 inch of clear space between finished surfaces and piping. Arrange hangers on adjacent parallel service lines in line with each other.
- H. Flange loads on connected equipment shall not exceed 75 percent of maximum allowed by equipment manufacturer. Flange loads in liquid containing systems shall be checked in the presence of the Architect when piping is full of liquid. No flange load is allowed on pumps, vibration isolated equipment or flexible connectors.
- I. Spring supports, within specified limitations: Constant support type, where necessary to avoid transfer of load from support to support or onto connected equipment; otherwise, variable support type located at points subject to vertical movement.
- J. Incorporate pipe anchors into piping systems to maintain permanent pipe positions. Install alignment guides for the piping adjacent to and on each side of pipe expansion loops and expansion joints to maintain alignment.
- K. Where necessary, brace piping and supports against reaction, sway and vibration.
- L. Do not hang piping from joist pans, floor decks, roof decks, equipment, ductwork, or other piping.
- M. Install turnbuckles, swing eyes and clevises to accommodate temperature changes, pipe accessibility, and adjustment for load pitch. Rod couplings are not acceptable.
- N. Install hangers and supports for piping at intervals specified, at locations not more than 3 feet from the ends of each runout, not more than 3 feet from connections to equipment, and not over 25 percent of specified interval from each change in direction of piping and for concentrated loads such as valves, etc.
- O. Base the load rating for pipe support elements on loads imposed by insulated weight of pipe filled with water. The span deflection shall not exceed slope gradient of pipe.
- P. If structural steel, roofs, or tunnels will allow support spacing greater than that shown above, Contractor shall submit proposed support system along with structural calculations documenting the allowance of such spacing, in accordance with ANSI, B31.1, and MSS Guidelines.
- Q. Support vertical risers independently of connected horizontal piping whenever practical, with supports at the base and at intervals to accommodate system range of load with thermal conditions. Support vertical risers at each floor penetration for

piping in shafts or chases. Guide for lateral stability. Fit horizontal piping connected to moving risers with two spring supports connected adjacent to riser, spaced according to required hanger spacing.

- R. For risers at temperatures of 100 deg F or less place riser clamps under fittings. Support carbon steel pipe at each operating level or floor and at not more than 15-foot intervals for pipe 2 inches and smaller, and at not more than 20 foot intervals for pipe 2-1/2 inches and larger.
- S. After the piping systems have been installed, tested and placed in satisfactory operation, firmly tighten hanger rod nut and jam nut and upset threads to prevent movement of fasteners.
- T. Attach pipe anchors and pipe alignment guides to the building structure where indicated. If not indicated, the method used is optional to the Contractor, subject to approval by the Architect. In the case of structural steel, make attachment by clamping in accordance with the American Institute of Steel Construction Specification for the Design, Fabrication and Erection of Structural Steel for Building.
- U. Attach supporting elements connected to structural steel columns to preclude vertical slippage and cascading failure.
- V. Attach pipe hangers and other supporting elements to roof purlins and trusses at panel points.
- W. Where eccentric loading beam clamps are approved and where other work is supported by similar eccentric loading support element from the same structural member, locate eccentric loading support elements to minimize structural member torsion load.
- X. Limit the location of supporting elements for piping and equipment, when supported from roof, to panel points of the bar joists.
- Y. Building structure shall not be reinforced except as approved by the Architect in writing.
- Z. Use approved cast-in-place inserts or built-in anchors for attachment to concrete structure. Size inserts and anchors for the total applied load with a safety factor in accordance with applicable codes but in no case less than 5. Coordinate installation of all imbedded items in accordance with manufacturer's instructions. Position anchorage and imbedded items as indicated and/or where required and support against displacement during placing of concrete. Cutting or repositioning of concrete beam or girder or reinforcing steel to accommodate inserts will not be allowed. Provide removable closures in imbedded device openings to prevent entry of concrete.
- AA. Support piping and equipment from concrete building frame, not from roof or floor slabs unless otherwise indicated.
- BB. Use cast-in-place inserts in concrete beams and girders. Drilled anchors/wedge type inserts shall be used on vertical surfaces only. Coordinate with structural engineer.
- CC. Attach piping supports to the side of concrete beams and concrete joist. Provide supplementary support steel as required. Cast-in-place or drilled anchors will not be permitted in the bottom of concrete beams and concrete joist.
- DD. Attach piping supports to the side of concrete beams or concrete joist. Where intermediate hangers are required to meet the hanger spacing schedule, the Contractor may propose attachment of intermediate pipe supports to the bottom of

the concrete slab pending submittal of a satisfactory pull out test. The Contractor shall submit pull out test criteria, pull out test results, proposed hanger detail and hanger point loads to the Architect for written approval.

- EE. Trapeze Pipe Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- FF. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
- GG. Fastener System Installation:
 - 1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- HH. Roof-Mounting Pipe and Equipment Stand Installation:
 - 1. Stand Types except Curb-Mounting Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
 - 2. Curb or Rail Mounting Type Stands: Assemble components or fabricate stand and mount on permanent, stationary roof curb or rail. Refer to Division 07 Section "Roof Accessories" for curb and rail installation.
 - 3. Maintain support manufacturer's recommended spacing.
- II. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- JJ. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- KK. Install hangers and supports to allow controlled thermal movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- LL. Install lateral bracing with pipe hangers and supports to prevent swaying.
- MM. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- NN. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- OO. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.
- PP. Refer to individual piping sections for hanger spacing and hanger rod sizes.

3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.6 PAINTING

- A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Equipment Supports: Painting is specified in Division 09 painting Sections.
- C. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.
- D. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 200529

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."

1.2 ACTION SUBMITTALS

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

1.3 INFORMATIONAL SUBMITTALS

- A. Samples: For color, letter style, and graphic representation required for each identification material and device.

- B. Valve numbering scheme.

1.4 CLOSEOUT SUBMITTALS

- A. Valve Schedules: For each piping system. Furnish extra copies (in addition to mounted copies) to include in Maintenance Manuals.

1.5 QUALITY ASSURANCE

- A. ASME Compliance: Comply with ASME (ANSI) A13.1, "Scheme for the Identification of Piping Systems," for letter size, length of color field, colors, and viewing angles of identification devices for piping.

1.6 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with location of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified:
 - 1. Seton.
 - 2. Brady.
 - 3. EMED.
 - 4. Craftmark.
 - 5. Brimar Industries, Inc.
 - 6. Marking Services Inc. (MSI).
 - 7. Kolbi Pipe Marker Co.

2.2 EQUIPMENT IDENTIFICATION DEVICES

- A. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.
 - 1. Data:
 - a. Manufacturer, product name, model number, and serial number.
 - b. Capacity, operating and power characteristics, and essential data.
 - c. Labels of tested compliances.
 - 2. Location: Accessible and visible.

3. Fasteners: As required to mount on equipment.
- B. Equipment Markers: Engraved, color-coded laminated plastic. Include contact-type, permanent adhesive.
1. Terminology: Match schedules as closely as possible.
 2. Data:
 - a. Name and plan number.
 - b. Equipment service.
 - c. Design capacity.
 - d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.
 3. Size: 2-1/2 by 4 inches for control devices, dampers, and valves; 4-1/2 by 6 inches for equipment.
- C. Equipment Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.
1. Data: Instructions for operation of equipment and for safety procedures.
 2. Engraving: Manufacturer's standard letter style, of sizes and with terms to match equipment identification.
 3. Thickness: Minimum 1/16 inch, unless otherwise indicated.
 4. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.
- D. Access Panel and Door Markers: 1/16-inch- thick, engraved laminated plastic, with abbreviated terms and numbers corresponding to identification. Provide 1/8-inch center hole for attachment.
1. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.
- ### 2.3 PIPING IDENTIFICATION DEVICES
- A. Manufactured Pipe Markers, General: Preprinted, color-coded, with lettering indicating service, and showing direction of flow.
1. Colors: Comply with ASME (ANSI) A13.1, unless otherwise indicated.
 2. Type and Size of Letters: Comply with ANSI A13.1, unless otherwise indicated.
 3. Legends: Spelled out in full or commonly used and accepted abbreviations.
 4. Pipes with OD, Including Insulation, Less Than 6 Inches: Full-band pipe markers extending 360 degrees around pipe at each location.
 5. Pipes with OD, Including Insulation, 6 Inches and Larger: Either full-band or strip-type pipe markers at least three times letter height and of length required for label.
 6. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.
- B. Pretensioned Pipe Markers: Precoiled semirigid plastic formed to cover full circumference of pipe and to attach to pipe without adhesive.
- C. Underground Pipe Markers: Bright colored continuously printed plastic ribbon tape of not less than 6 inches wide by 4mil thick, manufactured for direct burial service.

- D. Detectable Underground Pipe Markers: Continuously printed plastic ribbon tape with detectable aluminum core and with colors meeting APWA requirements, not less than 6 inches wide by 4 mil thick, manufactured for direct burial service.

2.4 DUCT IDENTIFICATION DEVICES

- A. Duct Markers: Engraved, color-coded laminated plastic. Include direction and quantity of airflow, air handling unit or fan number, and duct service (such as supply, return, and exhaust). Include contact-type, permanent adhesive.
- B. Duct Markers: Vinyl, 2-inch minimum character height, with permanent pressure sensitive adhesive. Include direction and quantity of airflow, air handling unit or fan number, and duct service (such as supply, return, and exhaust).

2.5 HAZARDOUS MATERIAL IDENTIFICATION DEVICES

- A. Standard: NFPA 704.
- B. Material: Engraved, color-coded laminated plastic. Include contact-type, permanent adhesive; or mounting screws.
- C. Size: Minimum 7-1/2 inches by 7-1/2 inches with 3-inch character height.
- D. Content: Appropriate for refrigerant.

2.6 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers, with numbering scheme approved by Architect/Engineer. Provide 5/32-inch hole for fastener.
 - 1. Material: 0.032-inch- thick brass.
 - 2. Valve-Tag Fasteners: Brass wire-link chain or beaded chain.

2.7 VALVE SCHEDULES

- A. Valve Schedules: For each piping system, on standard-size bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 - 1. Valve-Schedule Frames: Glazed display frame for removable mounting on masonry walls for each page of valve schedule. Include mounting screws.
 - 2. Frame: Finished hardwood or extruded aluminum.
 - 3. Glazing: ASTM C 1036, Type I, Class 1, Glazing Quality B, 2.5-mm, single-thickness glass.

2.8 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags; of plasticized card stock with matte finish suitable for writing.

1. Size: 3 by 5-1/4 inches minimum.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as DANGER, CAUTION, or DO NOT OPERATE.
4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 APPLICATIONS, GENERAL

- A. Products specified are for applications referenced in other Division 20, 21, 22, and 23 Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

3.2 EQUIPMENT IDENTIFICATION

- A. Install and permanently fasten equipment nameplates on each major item of mechanical equipment that does not have nameplate or has nameplate that is damaged or located where not easily visible. Locate nameplates where accessible and visible. Include nameplates for the following general categories of equipment:
 1. Fuel-burning units, including boilers, furnaces, heaters, stills, and absorption units.
 2. Pumps, compressors, chillers, condensers, and similar motor-driven units.
 3. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
 4. Fans, blowers, primary balancing dampers, and mixing boxes.
 5. Packaged HVAC central-station and zone-type units.
- B. Install equipment markers with permanent adhesive on or near each major item of mechanical equipment. Data required for markers may be included on signs, and markers may be omitted if both are indicated.
 1. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 2. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
 3. Locate markers where accessible and visible. Include markers for the following general categories of equipment:
 - a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
 - b. Fire department hose valves and hose stations.
 - c. Meters, gages, thermometers, and similar units.
 - d. Fuel-burning units, including boilers, furnaces, heaters, stills, and absorption units.
 - e. Pumps, compressors, chillers, condensers, and similar motor-driven units.
 - f. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
 - g. Fans, blowers, primary balancing dampers, and mixing boxes.
 - h. Packaged HVAC central-station and zone-type units.
 - i. Tanks and pressure vessels.

- j. Strainers, filters, humidifiers, water-treatment systems, and similar equipment.
 - C. Install equipment signs with screws or permanent adhesive on or near each major item of mechanical equipment. Locate signs where accessible and visible.
 - 1. Identify mechanical equipment with equipment markers in the following color codes:
 - a. Green: For cooling equipment and components.
 - b. Yellow: For heating equipment and components.
 - c. Orange: For combination cooling and heating equipment and components.
 - d. Brown: For energy-reclamation equipment and components.
 - 2. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - 3. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
 - 4. Include signs for the following general categories of equipment:
 - a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
 - b. Fuel-burning units, including boilers, furnaces, heaters, stills, and absorption units.
 - c. Pumps, compressors, chillers, condensers, and similar motor-driven units.
 - d. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
 - e. Fans, blowers, primary balancing dampers, and mixing boxes.
 - f. Packaged HVAC central-station and zone-type units.
 - g. Tanks and pressure vessels.
 - h. Strainers, filters, humidifiers, water-treatment systems, and similar equipment.
 - D. Install access panel markers with screws on equipment access panels.
 - E. Area Served: Equipment serving different areas of a building other than where the equipment is installed shall be permanently marked in a manner that, in addition to identifying the equipment as specified in this Section, also identifies the area it serves.

3.3 PIPING IDENTIFICATION

- A. Install manufactured pipe markers indicating service on each piping system. Install with flow indication arrows showing direction of flow.
 - 1. Pipes with OD, Including Insulation, Less Than 6 Inches: Pretensioned pipe markers. Use size to ensure a tight fit.
 - 2. Pipes with OD, Including Insulation, Less Than 6 Inches: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, minimum 3/4 inch wide, lapped at least 1-1/2 inches at both ends of pipe marker, and covering full circumference of pipe.
 - 3. Pipes with OD, Including Insulation, 6 Inches and Larger: Shaped pipe markers. Use size to match pipe and secure with fasteners.

4. Pipes with OD, Including Insulation, 6 Inches and Larger: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, minimum 1-1/2 inches wide, lapped at least 3 inches at both ends of pipe marker, and covering full circumference of pipe.
- B. Locate pipe markers and color bands where piping is exposed in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior non-concealed locations as follows:
1. Near each valve and control device.
 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 3. Near penetrations through walls, floors, ceilings, and non-accessible enclosures.
 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 5. Near major equipment items and other points of origination and termination.
 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 7. On piping above removable acoustical ceilings. Omit intermediately spaced markers.
- C. Underground Pipe Markers: Install 6 to 8 inches below finished grade, directly above buried pipe.

3.4 DUCT IDENTIFICATION

- A. Identify ductwork with vinyl markers and flow direction arrows.
- B. Locate markers at air handling units, each side of floor and wall penetrations, near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.5 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; plumbing fixture supply stops; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following:
1. Valve-Tag Size and Shape:
 - a. Cold Water: Minimum 1-1/2 inches, round or square.
 - b. Hot Water: Minimum 1-1/2 inches, round or square.
 - c. Fire Protection: Minimum 1-1/2 inches, round or square.
 - d. Gas: Minimum 1-1/2 inches, round or square.
 - e. Steam: Minimum 1-1/2 inches, round or square.

3.6 VALVE-SCHEDULE INSTALLATION

- A. Mount valve schedule on wall in accessible location in each major equipment room.

3.7 HAZARDOUS MATERIAL IDENTIFICATION DEVICES

- A. Mount to wall or door of room containing hazard. Indicate classification of refrigerant or other hazard.

3.8 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

3.9 ADJUSTING

- A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

3.10 CLEANING

- A. Clean faces of mechanical identification devices and glass frames of valve schedules.

3.11 SCHEDULES

- A. Paint colors are listed here for reference only. Painting is specified under Division 9.

PIPE LABELING AND COLOR CODING

<u>Pipe System Label</u>	<u>Drawing Abbrev.</u>	<u>Labels</u>	<u>Piping</u>
Sanitary Sewer	SAN	White on Green	Dark Brown
Sanitary Vent	V	White on Green	Dark Brown
Rain Conductor	RC	White on Green	Dark Brown
Acid Waste	AW	Black on Yellow	Black
Acid Vent	AV	Black on Yellow	Black
Domestic Cold Water	CW	White on Green	Light Green
High Pressure Domestic Cold Water	HPCW	White on Green	Light Green
Non-Potable Cold Water	NPCW	Black on Yellow	
Domestic Hot Water	HW	Black on Yellow	Dark Green
High Pressure Domestic Hot Water	HPHW	Black on Yellow	Dark Green
High Pressure Domestic Hot Water Return	HPHWR	Black on Yellow	Dark Green
Domestic Hot Water Return	HWR	Black on Yellow	Dark Green
Soft Cold Water	SCW	White on Green	Light Green
Soft Hot Water	SHW	White on Green	Dark Green
Soft Hot Water Return	SHWR	White on Green	Dark Green
Natural Gas	G	Black on Yellow	Yellow
Fuel Oil Supply	FOS	Black on Yellow	Yellow
Fuel Oil Return	FOR	Black on Yellow	Yellow
Compressed Air (90psig)	A(90psig)	Black on Yellow	Dark Blue
Compressed Air (25psig)	A	White on Green	Dark Blue
Laboratory Vacuum	LVAC	Black on Yellow	Unpainted
Carbon Dioxide	CO ₂	Black on Yellow	Unpainted
High Purity Water	DI	White on Green	White
Hot Water Htg. Supply	HWHS	Black on Yellow	Dark Blue
Hot Water Htg. Return	HWHR	Black on Yellow	Dark Blue
Terminal Unit Heating Sup.	THS	Black on Yellow	Dark Blue

<u>Pipe System Label</u>	<u>Drawing Abbrev.</u>	<u>Labels</u>	<u>Piping</u>
Terminal Unit Heating Ret.	THR	Black on Yellow	Dark Blue
Chilled Water Supply	CHWS	White on Green	Light Blue
Chilled Water Return	CHWR	White on Green	Light Blue
Refrigerant Liquid	RL	Black on Yellow	
Refrigerant Suction	RS	Black on Yellow	
Fire Protection	FP	White on Red	Bright Red
Medical Gases	Refer to Division 22 Section "Medical Gas Systems."		

SHEET METAL WORK

<u>Service</u>	<u>Abbrev.</u>	<u>Labels</u>	<u>Ductwork</u>
Air Conditioning Supply	Supply Air	White on Green	White
Air Conditioning Return	Return Air	White on Green	White
Exhaust Systems	Exhaust Air	Black on Yellow	Green
Outside Air Intake	Outside Air	White on Green	White
Mixed Air	Mixed Air	White on Green	White

END OF SECTION 200553

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:

1. Division 20 Section "Mechanical General Requirements."
2. Division 20 Section "Basic Mechanical Materials and Methods."
3. Division 20 Section "Hanger and Supports" for thermal hanger shield inserts.
4. Division 22 Section "Plumbing Fixtures: for protective shielding guards.
5. Division 22 Section "Healthcare Plumbing Fixtures" for protective shielding guards.
6. Division 23 Section "Metal Ducts" for duct liners.

1.2 SUMMARY

- A. This Section includes mechanical insulation for pipe, duct, and equipment.

1.3 DEFINITIONS

- A. ASJ: All-service jacket.
- B. FSK: Foil, scrim, kraft paper.
- C. PSK: Polypropylene, scrim, kraft paper.
- D. PVC: Polyvinyl Chloride.
- E. SSL: Self-sealing lap.

1.4 INDOOR PIPING INSULATION SYSTEMS DESCRIPTION

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are scheduled on the Drawings, or identified for each piping system and pipe size range.
- B. Sanitary Waste Piping Where Heat Tracing Is Installed, All Pipe Sizes: Glass-Fiber Pipe Insulation, Type I: 1-1/2 inches thick.

1.5 OUTDOOR, ABOVEGROUND PIPING INSULATION SYSTEMS DESCRIPTION

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are scheduled on the Drawings, or identified for each piping system and pipe size range.
- B. Sanitary or Storm Piping Where Heat Tracing Is Installed, All Pipe Sizes: Glass-Fiber Pipe Insulation, Type I: 2 inches thick.
- C. Fire-Suppression Piping Filled with Water:
 1. All Pipe Sizes: Insulation shall be either of the following:
 - a. Flexible Elastomeric: 2 inches thick.
 - b. Glass-Fiber Pipe Insulation, Type I: 2 inches thick.

1.6 INDOOR DUCT AND PLENUM INSULATION SYSTEMS DESCRIPTION

- A. Acceptable indoor duct and plenum insulation materials and thicknesses are scheduled on the Drawings.

1.7 ABOVEGROUND, OUTDOOR DUCT AND PLENUM INSULATION SYSTEMS DESCRIPTION

- A. Acceptable outdoor duct and plenum insulation materials and thicknesses are scheduled on the Drawings.

1.8 EQUIPMENT INSULATION SYSTEMS DESCRIPTION

- A. Acceptable equipment insulation materials and thicknesses are scheduled on the Drawings.

1.9 FIELD-APPLIED JACKETING SYSTEMS DESCRIPTION

- A. Acceptable field-applied jacketing materials and thicknesses are scheduled on the Drawings, or identified for each piping system and pipe specialty.
- B. Steam Condensate Piping within Air Handling Units: Aluminum, Stucco Embossed: 0.016 inch thick.
- C. Piping Within Energy Recovery Units: Type 304 Stainless Steel, Smooth: 0.010 inch thick. Seams and joints calked with chemically resistant sealer.
- D. Steam Pressure Reducing Valves: Sound Barrier Jacketing: Smooth or stucco embossed.

1.10 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated, identify thermal conductivity, thickness, and jackets (both factory and field applied, if any).
 - 1. ESR Report: For fire-rated grease duct insulation.

1.11 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.
- B. Ductwork Maximum Temperature Limits: Based on ASTM C 411 test procedures.

1.12 DELIVERY, STORAGE, AND HANDLING

- A. Prior to installation, protect insulation from exposure to water and from physical damage. Prior to installation, store insulation in manufacturer's original packaging.

1.13 COORDINATION

- A. Coordinate size and location of supports, hangers, and pre-insulated pipe shields/supports specified in Division 20 Section "Hangers and Supports."
- B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

1.14 SCHEDULING

- A. Schedule insulation application after pressure testing systems. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS, GENERAL REQUIREMENTS

- A. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- B. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- C. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- E. Adhesives used shall be fire resistant in their dry states and UL listed.

2.2 PIPE INSULATION MATERIALS

- A. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Aeroflex USA, Inc.; Aerocel Tube and Sheet.
 - b. Armacell LLC; AP Armaflex.
 - c. IK Insulation Group; K-Flex USA LLC; Insul-Tube and Insul-Sheet.
- B. Glass-Fiber, Preformed Pipe Insulation, Type I:

1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Johns Manville; Micro-Lok.
 - b. Knauf Insulation; 1000 Pipe Insulation.
 - c. Manson Insulation Inc.; Alley-K.
 - d. Owens Corning; Fiberglas Pipe Insulation.
 2. Type I, 850 deg F Materials: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ or ASJ-SSL. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.
- C. Mineral-Wool, Preformed Pipe Insulation, Type II:
1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Johns Manville.
 - b. Owens Corning/Thermafiber.
 - c. Rock Wool Manufacturing Company; Delta PC and PF.
 2. Type II, 1200 deg F Materials: Mineral wool fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type II, Grade A, with factory-applied, or field-applied ASJ or ASJ-SSL. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article. Field-applied jacket requirements are specified in Part 2 "Field-Applied Jackets" Article.

2.3 DUCTWORK INSULATION MATERIALS

- A. Blanket Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.
1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. CertainTeed Corp.; Duct Wrap.
 - b. Johns Manville; Microlite EQ.
 - c. Knauf Insulation; Duct Wrap.
 - d. Manson Insulation Inc.; Alley Wrap B.
 - e. Owens Corning; All-Service Duct Wrap.
- B. Board Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.
1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. CertainTeed Corp.; Commercial Board.
 - b. Fibrex Insulations Inc.; FBX.
 - c. Johns Manville; 800 Series Spin-Glas.
 - d. Knauf Insulation; Insulation Board.
 - e. Manson Insulation Inc.; AK Board.

- f. Owens Corning; Fiberglas 700 Series.

2.4 EQUIPMENT INSULATION MATERIALS

- A. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Aeroflex USA, Inc.; Aerocel Tube and Sheet.
 - b. Armacell LLC; AP Armaflex.
 - c. IK Insulation Group; K-Flex USA LLC; Insul-Tube and Insul-Sheet.
- B. Board Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For equipment applications, provide insulation with factory-applied ASJ. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. CertainTeed Corp.; Commercial Board.
 - b. Fibrex Insulations Inc.; FBX.
 - c. Johns Manville; 800 Series Spin-Glas.
 - d. Knauf Insulation; Insulation Board.
 - e. Manson Insulation Inc.; AK Board.
 - f. Owens Corning; Fiberglas 700 Series.
- C. Large Diameter Pipe and Tank Insulation: Glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. CertainTeed Corp.; CrimpWrap.
 - b. Johns Manville; MicroFlex.
 - c. Knauf Insulation; Pipe and Tank Insulation.
 - d. Manson Insulation Inc.; AK Flex.
 - e. Owens Corning; Fiberglas Pipe and Tank Insulation.

2.5 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to it and to surfaces to be insulated, unless otherwise indicated.
- B. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.

- a. Aeroflex USA, Inc.; Aero seal and Aero seal LVOC.
 - b. Armacell LCC; 520 Adhesive.
 - c. Foster Products Corporation, H. B. Fuller Company; 85-75.
- C. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Childers Products, H.B. Fuller Company; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. Johns Manville Industrial Insulation; S-90/80.
 - d. Marathon Industries, Inc.; 225.
 - e. Mon-Eco Industries, Inc.; 22-25.
- D. PVC Jacket Adhesive: Compatible with PVC jacket.
1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Dow Chemical Company (The); 739, Dow Silicone.
 - b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
 - c. P.I.C. Plastics, Inc.; Welding Adhesive.
 - d. Red Devil, Inc.; Celulon Ultra Clear.
 - e. Speedline Corporation; Speedline Vinyl Adhesive.

2.6 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.
- B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Childers Products, H.B. Fuller Company; CP-35.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-90.
 - c. Johns Manville Industrial Insulation; CB-50.
 - d. Marathon Industries, Inc.; 590.
 - e. Mon-Eco Industries, Inc.; 55-40.
 - f. Vimasco Corporation; 749.
 2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
 5. Color: White.
- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
1. Products: Subject to compliance with requirements, provide one of the products specified.

- a. Childers Products, H.B. Fuller Company; CP-10.
 - b. Foster Products Corporation, H. B. Fuller Company; 35-00.
 - c. Johns Manville Industrial Insulation; CB-05/15.
 - d. Marathon Industries, Inc.; 550.
 - e. Mon-Eco Industries, Inc.; 55-50.
 - f. Vimasco Corporation; WC-1/WC-5.
2. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.
 3. Service Temperature Range: Minus 20 to plus 200 deg F.
 4. Solids Content: 63 percent by volume and 73 percent by weight.
 5. Color: White.

2.7 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Childers Products, H.B. Fuller Company; CP-76-8.
 - b. Foster Products Corporation, H. B. Fuller Company; 95-44.
 - c. Marathon Industries, Inc.; 405.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Vimasco Corporation; 750.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.

B. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Childers Products, H.B. Fuller Company; CP-76.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.

2.8 FACTORY-APPLIED JACKETS

A. Insulation systems indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
4. PSK Jacket: Metalized polypropylene, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.9 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
- C. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
- D. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as specified; roll stock ready for shop or field cutting and forming.
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Airex Manufacturing, Inc.; E-Flex Guard.
 - b. Johns Manville; Zeston and Ceel-Co.
 - c. P.I.C. Plastics, Inc.; FG Series.
 - d. Proto PVC Corporation; LoSmoke.
 - e. Speedline Corporation; SmokeSafe.
 - 2. Adhesive: As recommended by jacket material manufacturer.
 - 3. Color: White.
 - 4. Factory-fabricated tank heads and tank side panels.
- E. PVC Fitting Covers: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C, and including flexible glass fiber insulation inserts.
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Airex Manufacturing, Inc.
 - b. Johns Manville; Zeston and Ceel-Co.
 - c. P.I.C. Plastics, Inc.; FG Series.
 - d. Proto PVC Corporation; LoSmoke.
 - e. Speedline Corporation; SmokeSafe.
 - 2. Adhesive: As recommended by manufacturer.
 - 3. Color: White.
 - 4. Factory-fabricated fitting covers:
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, and mechanical joints.
- F. Metal Jacket:
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. PABCO-Childers Metals; Johns Manville Industrial Insulation; Metal Jacketing Systems.
 - b. RPR Products, Inc.; Insul-Mate.

2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105 or 5005, Temper H-14.
 - a. Sheet and roll stock ready for shop or field sizing or factory cut and rolled to size.
 - b. Finish and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor Applications: 1-mil- thick, heat-bonded polyethylene and kraft paper.
 - d. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper or 2.5-mil- thick Polysurlyn.
 - e. Factory-Fabricated Fitting Covers:
 - 1) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - 2) Provide factory fabricated PVC tee covers, flange and union covers, beveled collars and valve covers.
 - 3) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
 3. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.
 - a. Sheet and roll stock ready for shop or field sizing factory cut and rolled to size.
 - b. Material, finish, and thickness are indicated in field-applied jacket systems.
 - c. Moisture Barrier for Indoor Applications: 1-mil- thick, heat-bonded polyethylene and kraft paper.
 - d. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper or 2.5-mil- thick Polysurlyn.
 - e. Factory-Fabricated Fitting Covers:
 - 1) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - 2) Provide factory fabricated PVC tee covers, flange and union covers, beveled collars and valve covers.
 - 3) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
- G. Self-Adhesive Outdoor Jacket for Piping: Laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a fabric reinforced insulation cladding with natural aluminum stucco embossed facing.
1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. 3M VentureClad; 1579GCW-E.
 - b. Polyguard; Alumaguard.
- H. Self-Adhesive Outdoor Jacket for Ductwork: Laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a crosslaminated polyethylene film covered with aluminum-foil facing.
1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. MFM Building Products Corp.; FlexClad-400.
 - b. Polyguard; Alumaguard.

- c. 3M VentureClad.

2.10 REMOVABLE AND REUSABLE INSULATION COVERS

- A. Flexible Style: Custom fabricated composite jackets for valves, flanges, and expansion joints consisting of 4 inches of high temperature fiberglass insulation compressed between Teflon impregnated fiberglass inner and outer facing stitched with fiberglass core Teflon thread and secured with Velcro fasteners and double D-ring cinching. Service temperature range of minus 40 deg F to 500 deg F.

- 1. Fabricators:

- a. Apex Energy & Environmental Products Inc.
- b. 3i Supply Co.; K-Tex.
- c. Valley Group of Companies.

- B. Rigid Style: Custom fabricated composite jackets for valves, flanges, and expansion joints consisting of rigid foam insulation with silicone impregnated fiberglass outer facing stitched with fiberglass thread and secured with Velcro fasteners and double D-ring cinching. Service temperature range of minus 40 deg F to 500 deg F.

- 1. Fabricators:

- a. Valley Group of Companies.

2.11 REMOVABLE AND REUSABLE ACOUSTIC INSULATION COVERS

- A. Flexible Style: Custom fabricated composite jackets consisting of:

- 1. Two inches of high temperature, high density, needled fiberglass mat insulation.
- 2. High density mass loaded vinyl
- 3. Teflon impregnated fiberglass inner and outer facing with double sewn and bonded seams.
- 4. Extended Velcro flap on closing seams.
- 5. Stainless steel lacing hardware with wire twist fastener.
- 6. Include aluminum nameplate having embossed lettering with tag description.

- B. Manufacturer:

- 1. Shannon Enterprises of W.N.Y. Inc.; INSULTECH; LT450A-TT Series.

2.12 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136 and UL listed.

- 1. Basis-of-Design Product: Subject to compliance with requirements, provide Ideal Tape Co., Inc., an American Biltrite company; 728 Cold Seal ASJ or comparable products by one of the following:

- a. Avery Dennison Corporation, Specialty Tapes Division.
- b. 3M Venture Tape.

- 2. Width: 3 inches.

3. Thickness: 9 mils.
 4. Adhesion: 70 ounces force/inch in width.
 5. Elongation: 3 percent.
 6. Tensile Strength: 45 lbf/inch in width.
 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with rubber or acrylic adhesive; complying with ASTM C 1136 and UL listed.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Ideal Tape Co., Inc., an American Biltrite company; 491 FSK or 791 Cold Seal Acrylic FSK, or comparable products by one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division.
 - b. 3M Venture Tape.
 2. Width: 3 inches.
 3. Thickness: 6 mils.
 4. Adhesion (Rubber Adhesive): 100 ounces force/inch in width.
 5. Adhesion (Acrylic Adhesive): 90 ounces force/inch in width.
 6. Elongation: 3 percent.
 7. Tensile Strength: 35 lbf/inch in width.
 8. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Ideal Tape Co., Inc., an American Biltrite company; 370 White PVC tape, or comparable products by one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division.
 - b. 3M Venture Tape.
 2. Width: 2 inches.
 3. Thickness: 5 mils.
 4. Adhesion: 20 ounces force/inch in width.
 5. Elongation: 500 percent.
 6. Tensile Strength: 15 lbf/inch in width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive and UL listed.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Ideal Tape Co., Inc., an American Biltrite company; 488 AWF rubber adhesive or 788 Cold Seal acrylic adhesive, or comparable products by one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division.
 - b. 3M Venture Tape.
 2. Width: 3 inches.
 3. Thickness: 3.0 to 4.0 mils.
 4. Adhesion (Rubber Adhesive): 90 ounces force/inch in width.
 5. Adhesion (Acrylic Adhesive): 50 ounces force/inch in width.
 6. Elongation: 3 percent.
 7. Tensile Strength: 14 to 20 lbf/inch in width.

2.13 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. PABCO-Childers Metals; Johns Manville Industrial Insulation; Pab-Bands and Fabstraps.
 - b. RPR Products, Inc.; Bands.
2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing or closed seal.
3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing or closed seal.
4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
 - a. Products: Subject to compliance with requirements, provide one of the products specified.
 - 1) AGM Industries, Inc.; CWP-1.
 - 2) GEMCO; CD.
 - 3) Midwest Fasteners, Inc.; CD.
 - 4) Nelson Stud Welding; TPA, TPC, and TPS.
2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
 - a. Products: Subject to compliance with requirements, provide one of the products specified.
 - 1) AGM Industries, Inc.; CWP-1.
 - 2) GEMCO; Cupped Head Weld Pin.
 - 3) Midwest Fasteners, Inc.; Cupped Head.
 - 4) Nelson Stud Welding; CHP.
3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, provide one of the products specified.
 - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series T.
 - 2) GEMCO; Perforated Base.
 - 3) Midwest Fasteners, Inc.; Spindle.

- b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, provide one of the products specified.
 - 1) GEMCO; Nylon Hangers.
 - 2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.
 - b. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
 - c. Spindle: Nylon, 0.106-inch- diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, provide one of the products specified.
 - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series TSA.
 - 2) GEMCO; Press and Peel.
 - 3) Midwest Fasteners, Inc.; Self Stick.
 - b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive-backed base with a peel-off protective cover.
6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
 - a. Products: Subject to compliance with requirements, provide one of the products specified.
 - 1) AGM Industries, Inc.; RC-150.
 - 2) GEMCO; R-150.
 - 3) Midwest Fasteners, Inc.; WA-150.
 - 4) Nelson Stud Welding; Speed Clips.

- b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
- 7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
 - a. Manufacturers:
 - 1) GEMCO.
 - 2) Midwest Fasteners, Inc.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.
- D. Wire: 0.062-inch soft-annealed, stainless steel.
 - 1. Manufacturers:
 - a. ACS Industries, Inc.
 - b. C & F Wire.
 - c. PABCO-Childers Metals; Johns Manville Industrial Insulation.
 - d. RPR Products, Inc.

2.14 CORNER ANGLES

- A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.
- B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105 or 5005; Temper H-14.
- C. Stainless-Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch, stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or 316.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
 - 1. Verify that systems and equipment to be insulated have been tested and are free of defects.
 - 2. Verify that surfaces to be insulated are clean and dry.
 - 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that applies to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 COMMON INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at the 4 o'clock or 8 o'clock position on horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive as recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. For services with surface temperatures below ambient, install a continuous unbroken vapor barrier. Seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install thermal hanger insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover thermal hanger inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at the 4 o'clock or 8 o'clock position on the pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness. Where compression of insulation is possible, fabricate/install insulation per manufacturer's recommendations.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above ambient services, do not install insulation to the following:
1. Vibration-control devices.
 2. Testing agency labels and stamps.
 3. Nameplates and data plates.
 4. Manholes.
 5. Handholes.
 6. Cleanouts.

3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Below-Grade Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.

2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations that Are Not Fire Rated: Install insulation through walls and partitions as detailed.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations:
1. Terminate ductwork insulation at angle closure of fire damper sleeves.
 2. Install pipe insulation continuously through penetrations of fire-rated walls and partitions.
 - a. Firestopping is specified in Division 07 Section "Through-Penetration Firestop Systems."
- F. Insulation Installation at Floor Penetrations:
1. Duct: Install insulation through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at angle closure of fire damper sleeves.
 2. Pipe: Install insulation continuously through floor penetrations.
 - a. Seal penetrations through fire-rated assemblies according to Division 07 Section "Through-Penetration Firestop Systems."

3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this Article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.

5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services not specified to receive a field-applied jacket except for flexible Elastomeric, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
 9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
 3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
 5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.
- E. Install removable and reusable insulation covers in accordance with fabricator's instructions, and at the following locations:
1. At steam valves.
 2. At valves, flanges, and expansion joints. Expansion joints shall have jacket installed in a manner to allow for replacing of joints without removing insulation cover.

3.6 FLEXIBLE ELASTOMERIC PIPE INSULATION INSTALLATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
 - 1. Install pipe insulation to outer diameter of pipe flange.
 - 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 - 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
 - 4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
 - 1. Install mitered sections of pipe insulation.
 - 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- D. Insulation Installation on Valves and Pipe Specialties:
 - 1. Install preformed valve covers manufactured of same material as pipe insulation when available.
 - 2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 - 3. Install insulation to flanges as specified for flange insulation application.
 - 4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 GLASS-FIBER AND MINERAL WOOL PIPE INSULATION INSTALLATION

- A. Insulation Installation on Straight Pipes and Tubes:
 - 1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
 - 2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
 - 3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
 - 4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
- B. Insulation Installation on Pipe Flanges:
 - 1. Install PVC fitting covers when available.
 - 2. When PVC fitting covers are not available, install preformed pipe insulation to outer diameter of pipe flange:

- a. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 - b. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with fiberglass or mineral wool blanket insulation as specified for system.
3. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install PVC fitting covers when available.
2. When PVC fitting covers are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install PVC fitting covers when available.
2. When PVC fitting covers are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.8 DUCT AND PLENUM INSULATION INSTALLATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with insulation pins.

1. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not over compress insulation during installation.
 - e. Impale insulation over pins and attach speed washers.
 - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
2. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.

- b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.
 3. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
 4. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
 5. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.
- B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
 1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not over compress insulation during installation.
 - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.
 5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible

- to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.
- C. Flexible Elastomeric Thermal Insulation Installation for Ducts and Plenums: Install insulation over entire surface of ducts and plenums.
1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
 2. Seal longitudinal seams and end joints.
 3. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with strips of same material used to insulate duct and following manufacturer's installation instructions.

3.9 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION

- A. Secure insulation with adhesive and anchor pins and speed washers.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces.
 2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
 3. Protect exposed corners with secured corner angles.
 4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:
 - a. Do not weld anchor pins to ASME-labeled pressure vessels.
 - b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
 - c. On tanks and vessels, maximum anchor-pin spacing is 3 inches from insulation end joints, and 16 inches o.c. in both directions.
 - d. Do not over compress insulation during installation.
 - e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
 - f. Impale insulation over anchor pins and attach speed washers.
 - g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
 6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches from each end. Install wire or cable between two circumferential girdles 12 inches o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches o.c. Use this network for securing insulation with tie wire or bands.
 7. Stagger joints between insulation layers at least 3 inches.

8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
 9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
 10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.
- B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.
1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
 2. Seal longitudinal seams and end joints.
- C. Insulation Installation on Pumps:
1. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch centers, starting at corners. Install 3/8-inch-diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism.
 2. Fabricate boxes from galvanized steel, at least 0.040 inch thick.
 3. For below ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.

3.10 FIELD-APPLIED JACKET INSTALLATION

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
 2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
 3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.
- E. Where self-adhesive jackets are indicated, install according to manufacturer's instructions and details on the drawings. Overlap seams arranged to shed water.
- F. Where sound barrier jackets are indicated, install in accordance with manufacturer's instructions.

3.11 FINISHES

- A. Duct, Equipment, and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system specified in Division 09 painting Sections.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

END OF SECTION 200700

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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 work of this section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."
 - 3. Division 20 Section "Motors."

1.2 REFERENCES

- A. ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
- B. ABMA 11 - Load Ratings and Fatigue Life for Roller Bearings.
- C. ANSI/NEMA MG 1 - Motors and Generators.

1.3 DEFINITIONS

- A. BAS: Building automation system.
- B. EMI: Electromagnetic interference.

- C. LED: Light-emitting diode.
- D. RFI: Radio-frequency interference.
- E. THD: Total harmonic disturbance.
- F. VFC: Variable frequency controller. Variable frequency controllers may also be referred to as variable speed drives, variable frequency drives, VSDs, or VFDs in other Specification Sections or on the Drawings.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type and rating of VFC indicated.
 - 1. Include dimensions and finishes for VFCs.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.5 INFORMATIONAL SUBMITTALS

- A. Shop Drawings: Indicating power, control and instrument wiring including ladder diagrams for field work as well as factory assembled work. Manufacturer's drawings are acceptable only when modified and supplemented to reflect project conditions. The drawings shall include:
 - 1. Overall schematic (elementary) diagram in JIC form of the entire system of power and control circuitry. Indicate interfaces with control wiring by temperature controls contractor.
 - 2. Wiring diagrams showing the wiring layout of component assemblies or systems.
 - 3. Interconnection wiring diagrams showing terminations of interconnecting conductors between component assemblies, systems, control devices, and control panels complete with conductor identification, number of conductors, conductor and conduit size.
 - 4. Sequence of operation for components, assemblies or systems.
 - 5. Dimensional data.
- B. Product Certificates: For each VFC from manufacturer.
- C. Harmonic Analysis Report: Provide Project-specific calculations and manufacturer's statement of compliance with IEEE 519.
- D. Coordination Data for Motor-Driven Equipment: Accompanied by complete information concerning the respective motors including the following.
 - 1. Principal dimensions.
 - 2. Weights.
 - 3. Horsepower.
 - 4. Voltage, phase, frequency.
 - 5. Speed.
 - 6. Class of insulation.
 - 7. Enclosure type.
 - 8. Frame.
 - 9. Bearings including ABMA Rating Life (L-10 basis).
 - 10. Design letter.
 - 11. Manufacturer.
 - 12. Service Factor

- E. Descriptive data shall include catalogues, guaranteed performance data with efficiency and power factor indicated at 75 percent and 100 percent of rated load and verification of conformance with other requirements of the Contract Documents. The information enumerated under NEMA MG1 Paragraph MG1-10.38, shall be arranged on one sheet for each motor.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For VFCs to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
 - 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
- B. Product Options for Restricted Space: Drawings indicate maximum dimensions for VFCs, including clearances between VFCs, and adjacent surfaces and other items. Refer to Division 01 Section "Product Requirements."
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Comply with NFPA 70.
- E. Comply with IEEE 519 - Recommended Practice and Requirements for Harmonic Control in Electric Power Systems.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store VFCs in permanently enclosed and conditioned spaces.
- B. If stored in space that is not permanently enclosed and conditioned, remove loose packing and flammable materials from inside controllers and install temporary electric heating, with at least 250 W per controller.

1.9 COORDINATION

- A. For Electrical Work Provided under Division 20, 22, and 23 Specifications: Furnish UL Listed components, in accordance with Division 26 Specifications and applicable NEMA and NEC (ANSI C 1) requirements. Provide wiring, external to electrical enclosures, in conduit.
- B. Provide Electrical Work required for the operation of components and assemblies provided as part of the Work under Division 20, 22, and 23 Specifications.
- C. Coordinate with temperature controls contractor for interfaces with temperature controls wiring.

- D. Mount line voltage (120 VAC) control components specified as part of the Work under Division 20, 22, and 23 Specifications.
- E. Refer to ELECTRICAL DRAWINGS and Division 26 Specifications for specified information regarding provisions for the arrangement of electrical circuits and components and for interface with Work specified under Division 20, 22, and 23 Specifications.
- F. The mechanical contractor shall furnish and install the variable frequency controller. Electrical trades shall make power connections to both load and line side of the VFC.

1.10 WARRANTY

- A. Warranty shall be 36 months from date of project acceptance. The warranty shall include all parts, labor, travel time and expenses.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Electrical Power Supply Characteristics: 480 volts, 3 phase, 60 hertz (Hz).
- B. Controller(s) shall be suitable for use with standard NEMA-B squirrel-cage induction motor(s) having a 1.15 Service Factor. At any time in the future, it shall be possible to substitute standard motor (equivalent horsepower, voltage and RPM) in the field.

2.2 VARIABLE FREQUENCY CONTROLLERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
 - 1. Yaskawa Electric America, Inc.
- B. Provide variable frequency controllers as scheduled including coasting motor restart, and step over frequency.
 - 1. The ratio of the total impedance to common system impedance shall be greater than or equal to 10.
 - 2. The voltage notch area shall be limited to 16-400 volt microseconds.
 - 3. The total harmonic disturbance (THD) as a result of voltage notching shall be 3 percent or less at the point of common coupling.
 - 4. The THD as a result of current notching shall be 100 percent or less at the point of common coupling.
- C. Provide 3 percent AC input line reactors sized appropriate for each current rating variable frequency controller.
- D. Variable frequency controller (VFC) shall comply with all applicable provisions of the National Electrical Code.
- E. Line side of the VFC shall have a displacement power factor of 0.95 or greater when motor is operating at 50 to 100 percent motor speed.

- F. VFC shall have efficiency greater than 85 percent when motor is operating at 50 to 100 percent motor speed.
- G. Design and Rating: Match load type, such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.
- H. Unit Operating Requirements:
 - 1. Input AC Voltage Tolerance: Plus 10 and minus 5 percent of VFC input voltage rating.
 - 2. Input Frequency Tolerance: Plus 2 percent of VFC frequency rating.
- I. Each variable frequency controller shall consist of an adjustable frequency converter which shall convert input power into an adjustable frequency output in an ambient temperature of zero to 40 deg C. Output power shall be suitable capacity and waveform to provide stepless speed control of the specified horsepower motor throughout the required speed range under variable torque load not exceeding the motor's full-load rating.
- J. Provide fault detection and trip circuits to protect itself and the connected motor against line voltage transients, power line under voltage, output overvoltage and overcurrent. A disconnect with padlockable door interlocked external handle shall be supplied to disconnect the incoming power.
 - 1. Minimum SCCR according to UL 508 shall be as indicated on the Drawings, whichever is greater.
- K. Minimum output frequency shall be the lowest frequency at which the connected motor can be operated without overheating.
- L. Inverter shall contain current limiting circuitry, adjustable to 100 percent of motor full-load current to provide soft start, acceleration, and running without exceeding motor rated current. The current limit circuit shall be of the type for variable torque load, which acts to diminish output frequency while limiting, without directly causing shutdown.
- M. Automatic Reset/Restart: Attempt three restarts after drive fault or on return of power after an interruption and before shutting down for manual reset or fault correction; adjustable delay time between restart attempts. For safety, drive shall shut down and require manual reset and restart if automatic reset/restart function is not successful within three attempts.
- N. Bidirectional Autospeed Search: Capable of starting VFC into rotating loads spinning in either direction and returning motor to set speed in proper direction, without causing damage to drive, motor, or load.
- O. Isolate signal circuits from the power circuits and design to accept a speed signal from a remote process controller in the automatic mode and from the speed control potentiometer in the manual mode. A door-mounted switch shall provide mode selection. The selected signal shall control the motor speed between the adjustable minimum and maximum speed settings. Maximum speed shall be field adjustable to 100 percent of rated speed. The speed signal shall follow a linear time ramp, adjustable from 4-20 seconds to provide acceleration from zero to minimum speed. When minimum speed is reached, the speed signal shall follow the linear time ramp for acceleration and deceleration control.

- P. Mount the adjustable frequency inverter and other electrical components that provide the operation specified in a NEMA 4 enclosure. Equipment shall have external heat sinks, or air filters on all vents. The enclosure shall have hinged front access doors with latch. Cabinet to cabinet interconnecting wiring shall be factory dressed, tagged and harnessed, and shipped with one end attached.
- Q. Controller shall have the ability to step-over certain set frequencies that may cause a system to resonate. The controller shall have at least two manually set points of frequency in which the controller shall step-over during operation.
- R. Operating and monitoring devices for the inverter shall be door mounted and shall include the following:
1. Manual Speed Control to set speed in the hand (manual) mode.
 2. Speed indicating meter, either in revolutions per minute, proportional to the applied frequency and voltage to indicate speed of the converter-powered motor or frequency (hertz).
 3. VFC "fault/reset" pilot light pushbutton combination with dry contact for external alarm. Fault alarm shall not actuate upon normal shutdown.
 4. Inverter "control power" indicator.
 5. Motor "running" indicator and two dry contacts that close when motor is running.
 6. Output current meter calibrated in "AC amps."
 7. Operating selector switches and indicating light to perform the following functions:
 - a. One hand-off-auto switch for the VFC with indicating lights (red-running, green-energized). In hand position, unit (VFC or bypass starter) shall start. In auto position, unit (VFC or bypass starter) shall start when remote dry contact is closed.
 - b. Unit shall be capable of being padlocked in the off position.
 8. Output voltmeter (0 - 600 VAC) (analog or digital).
- S. The VFC is to be provided with isolated 4-20 mA DC output signals proportional to speed, current and voltage for connection by others.
- T. The VFC shall be provided with the ability to communicate (monitoring) through RS485 connector.
- U. Remote speed control shall be a 3-15 psig pneumatic signal from a remote controller. Provide a pressure transducer in the VFC enclosure to convert the pneumatic signal to an electrical signal for automatic speed control.
- V. Remote speed control shall be 4-20 mA control signal from a remote controller.
- W. Automatic bypass starter shall be as follows:
1. Single-Speed Non-reversing Starter: Consisting of a full voltage magnetic starter with two convertible auxiliary contacts, thermal overloads, control transformer and control devices as indicated and as specified, all mounted and wired in a separate sectioned part of VFC enclosure.
 2. Interlocking: Equip switch with an external operating handle. Interlock the operating handle such that the door cannot be opened unless the switch is in the "off" position. Provide means for padlocking the operating handle in the "off" position with three 5/16 inch shackle padlocks such that when the operating handle is padlocked in the "off" position, the cover door cannot be opened and the switch cannot be closed.

3. Starter: Size starters per the horsepower of the motors with which they will be used, except do not furnish starters smaller than NEMA Size 1 for motors of 5 horsepower or less. Provide coils for operation on 120 volts AC unless other requirements are indicated. Equip each starter with a minimum of two convertible auxiliary contacts in addition to the normally-open seal-in contact, unless additional requirements are indicated. Provide additional contacts as indicated.
 4. Thermal Overload: One in each phase wire, manual reset type. Select overloads after final installed horsepower of motor is determined. Do not use ratings exceeding 100 percent of motor full load current adjusted for ambient temperatures.
 5. Control Transformer: Provide a 120 volt control transformer in the starter enclosure. Fuse and ground the secondary winding as indicated. Where indicating lights or other control components are to be energized from the control transformer, increase the capacity of the control transformer to 200 VA.
 6. Bypass/VFC starter shall consist of 3 contactors or have a drive disconnect as well as a main disconnect for isolation purposes.
- X. Variable frequency controller shall not cause motor to produce noise levels exceeding 80 dBA measured at a distance of 3 feet from the motor. If noise level of motor exceeds this amount, the contractor shall be responsible for correcting the problem.
- Y. Provide connection points for system safety controls such as smoke detectors, freeze stats, damper end switches, etc. as shown on mechanical temperature control drawings. Opening of a contact on safety controls wired to the drive shall shut down the motor(s)
- Z. VFCs specified on the drawings to have contactor motor selection, in order to operate "either one or both" motors connected to the VFC, shall have the separate motors controlled by horse power rated contactors. These contactors shall be capable of being controlled locally (by a switch in the panel door) or remotely. The contactors shall also have two convertible auxiliary contacts in order to sense contactor position.
- AA. VFCs specified on the drawings to operate "either" motor with contactor motor selection shall have separate horse power rated contactors to control each motor.
- BB. The contactors shall be interlocked in order that only one motor may run at a time. These contactors shall be capable of being controlled locally (by a switch in the panel door) or remotely. The contactors shall also have two convertible auxiliary contacts in order to sense contactor position.
- CC. Provide in each VFC, a relay, that upon loss of the automatic speed control signal shall:
- DD. Coordinate with the Temperature Controls Contractor for the interface of control wiring to the drive as required to meet the requirements of the temperature control drawings. Drive shall be furnished with internal control wiring configured in the factory to allow single connections of field wiring to terminal blocks in the drive by the Temperature Controls Contractor.
- EE. All indicating lights shall be push to test or LED.
- 2.3 SOURCE QUALITY CONTROL
- A. Factory Tests: The controller shall be subject to, but not limited to, the following quality assurance controls, procedures and tests:

1. Power transistors, SCRs and diodes shall be tested to ensure correct function and highest reliability.
2. All printed circuit boards shall be tested at 50 deg C for 50 hours. The VFC manufacturer shall provide certification that the tests have been completed.
3. Every controller will be functionally tested with a motor to ensure that if the drive is started up according to the instruction manual provided, the unit will run properly.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, surfaces, and substrates to receive VFCs, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance.
- B. Examine VFC before installation. Reject VFCs that are wet, moisture damaged, or mold damaged.
- C. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFC installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install and adjust materials and equipment in accordance with the manufacturer's instructions.
- B. Obtain the manufacturer's instructions for materials and equipment provided under the Contract in detail necessary to comply with the requirements of the Contract Documents.
- C. If unit is free standing, provide a concrete housekeeping pad.

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Upon completion of each installation, conduct complete acceptance tests in the presence of duly notified authorities having jurisdiction and the Owner to demonstrate component, assembly or system performance in accordance with the requirements of the Contract Documents.
- C. In the event that a test demonstrates that a component assembly or system performance is deficient, the Owner may require additional tests after corrective work.
- D. Prepare test and inspection reports, including a certified report that identifies the VFC and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

- E. Component assembly and systems acceptance is predicated upon completion of specified work and receipt by the Owner of data specified under "Submittals."
- F. Electrical testing of motors is specified in Division 20 Section "Motors."

3.4 ADJUSTING

- A. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.
- B. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.
- C. Adjust the trip settings of instantaneous-only circuit breakers and thermal-magnetic circuit breakers with adjustable, instantaneous trip elements. Initially adjust to 6 times the motor nameplate full-load amperes and attempt to start motors several times, allowing for motor cool-down between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed 8 times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Construction Manager before increasing settings.
- D. Set the taps on reduced-voltage autotransformer controllers.
- E. Set field-adjustable circuit-breaker trip ranges.
- F. Set field-adjustable pressure switches.

3.5 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until controllers are ready to be energized and placed into service.
- B. Replace VFCs whose interiors have been exposed to water or other liquids prior to Substantial Completion.

3.6 DEMONSTRATION

- A. The VFC supplier/support group shall provide the following additional services:
 - 1. On-site training of customer personnel in operation and maintenance of variable frequency controllers.
 - 2. Provide four copies of a troubleshooting manual and factory training manuals to help the building operator determine what steps must be taken to correct any problem that may exist in the system.
 - 3. Coordinate enrollment of customer personnel in factory-held service schools.

END OF SECTION 202923

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Provisions of Division 20 Section "Mechanical General Requirements" apply to this Section.
- C. Related Sections include the following:
 - 1. Division 10 Section "Fire-Protection Specialties" for cabinets and fire extinguishers.
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."
 - 3. Division 20 Section "Hangers and Supports."
 - 4. Division 21 fire pump sections for fire pumps, pressure-maintenance pumps, and pump controllers.
 - 5. Division 21 Section "Foam Fire Extinguishing" for extinguishing systems.
 - 6. Division 21 clean-agent extinguishing system sections.
 - 7. Division 28 Section "Fire Alarm" for alarm devices not specified in this Section.

1.2 DEFINITIONS

- A. CR: Chlorosulfonated polyethylene synthetic rubber.
- B. High-Pressure Piping System: Fire-suppression piping system designed to operate at working pressure higher than standard 175 psig.
- C. PE: Polyethylene plastic.
- D. Underground Service-Entrance Piping: Underground service piping below the building.
- E. Hose Connection: Valve with threaded outlet matching fire hose coupling thread for attaching fire hose.
- F. Hose Station: Hose connection, fire hose rack, and fire hose.
- G. Working Plans: Documents, including drawings, calculations, and material specifications prepared according to NFPA 13 and NFPA 14 for obtaining approval from authorities having jurisdiction.

1.3 SYSTEM DESCRIPTIONS

- A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

1.4 PERFORMANCE REQUIREMENTS

- A. Standard Piping System Component Working Pressure: Listed for at least 175 psig.
- B. High-Pressure Piping System Component Working Pressure: Listed for 300 psig.
- C. Delegated Design: Design sprinkler system(s), including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- D. Fire-suppression sprinkler system design shall be approved by authorities having jurisdiction.
 - 1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
 - 2. Sprinkler Occupancy Hazard Classifications, for bidding purposes, as follows:
 - a. Building Service Areas: Ordinary Hazard, Group 1.
 - b. Electrical Equipment Rooms: Ordinary Hazard, Group 1.
 - c. General Storage Areas: Ordinary Hazard, Group 1.
 - d. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
 - e. Office and Public Areas: Light Hazard.
 - 3. Minimum Density for Automatic-Sprinkler Piping Design:
 - a. Light-Hazard Occupancy: 0.10 gpm/sq. ft. over 1500-sq. ft. area.
 - b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.
 - 4. Maximum Protection Area per Sprinkler:
 - a. Office Spaces: 120 sq. ft.
 - b. Storage Areas: 130 sq. ft.
 - c. Mechanical Equipment Rooms: 130 sq. ft.
 - d. Electrical Equipment Rooms: 130 sq. ft.
 - e. Other Areas: According to NFPA 13 recommendations, unless otherwise indicated.
 - 5. Total Combined Hose-Stream Demand Requirement: According to NFPA 13, unless otherwise indicated:
 - a. Light-Hazard Occupancies: 100 gpm for 30 minutes.
 - b. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes.
 - c. Extra-Hazard Occupancies: 500 gpm for 90 to 120 minutes.
- E. Water velocity in the piping system shall not exceed the following:
 - 1. Underground mains: 16 ft./sec.
 - 2. Aboveground mains: 20 ft./sec.
 - 3. Sprinkler branch lines: 20 ft./sec.

1.5 ACTION SUBMITTALS

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

1.6 INFORMATIONAL SUBMITTALS

- A. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Wiring Diagrams: For power, signal, and control wiring.
- B. Delegated-Design Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Domestic water piping.
 - 2. HVAC hydronic piping.
 - 3. Items penetrating finished ceiling include the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
- D. Qualification Data: For qualified Installer.
- E. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, the Owner's insurance underwriter including hydraulic calculations, if applicable.
 - 1. Sprinklers shall be referred to on drawings, submittals, and other documentation, by the sprinkler identification number (SIN) or model number as specifically published in the appropriate agency listing or approval. Trade names or other abbreviated designations shall not be allowed.
- F. Fire-hydrant flow test report.

1.7 CLOSEOUT SUBMITTALS

- A. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping"
- B. Field quality-control reports.
- C. Operation and Maintenance Data: For specialties to include in operation and maintenance manuals.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Installer's responsibilities include designing, fabricating, and installing fire-suppression systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.

- a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.
- B. The provisions and requirements of the NFPA and the Owner's insurance underwriter constitute mandatory minimum requirements for the work of this Section.
- C. NFPA Standards: Fire-suppression-system equipment, specialties, accessories, installation, and testing shall comply with the following:
 - 1. NFPA 13, "Installation of Sprinkler Systems."
 - 2. NFPA 13R, "Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height."
- D. Grooved couplings, fittings, valves, and specialties shall be the products of a single manufacturer.

1.9 COORDINATION

- A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

1.10 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Sprinkler Cabinets: Finished, wall-mounting, steel cabinet with hinged cover, with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler on Project.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 STANDARD-WEIGHT BLACK STEEL PIPE AND FITTINGS

- A. Threaded-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, with factory- or field-formed threaded ends, and with factory applied antimicrobial coating on inner wall of pipe.
 - 1. Cast-Iron Threaded Flanges: ASME B16.1.
 - 2. Malleable-Iron Threaded Fittings: ASME B16.3.
 - 3. Gray-Iron Threaded Fittings: ASME B16.4.

4. Steel Threaded Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, seamless steel pipe. Include ends matching joining method.
 5. Steel Threaded Couplings: ASTM A 865.
- B. Plain-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, and with factory applied antimicrobial coating on inner wall of pipe.
1. Steel Welding Fittings: ASTM A 234/A 234M, and ASME B16.9 or ASME B16.11.
 2. Steel Flanges and Flanged Fittings: ASME B16.5.
- C. Grooved-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, with factory- or field-formed, square-cut- or roll- grooved ends, and with factory applied antimicrobial coating on inner wall of pipe.
1. Grooved-Joint Piping Systems:
 - a. Manufacturers:
 - 1) Anvil; Models 74FP and 7401; ASC Engineered Solutions.
 - 2) Tyco Fire Protection Products by Johnson Controls Company; Grinnell G-Fire.
 - 3) Victaulic Co. of America; Style 005H, 009N, 107N and 109.
 - b. Grooved-End Fittings: UL-listed, ASTM A 536, ductile-iron casting with OD matching steel-pipe OD.
 - c. Grooved-End-Pipe Couplings: UL 213 and AWWA C606, rigid pattern, unless otherwise indicated; gasketed fitting matching steel-pipe OD. Include ductile-iron housing with keys matching steel-pipe and fitting grooves, rubber gasket listed for use with housing, and steel bolts and nuts.

2.3 BACKFLOW PREVENTION DEVICES

- A. Double-Check, Detector-Assembly Backflow Preventers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.
 - b. FEBCO; a Division of Watts Water Technologies, Inc.
 - c. Watts Water Technologies, Inc.; Ames Fire & Waterworks.
 - d. Watts Water Technologies, Inc.; Watts Regulator Co.
 - e. Zurn Plumbing Products Group; Wilkins Div.
 2. Standard: ASSE 1048 and FMG approved or UL listed.
 3. Operation: Continuous-pressure applications.
 4. Pressure Loss: 5 psi maximum, through middle 1/3 of flow range.
 5. Size and Capacities: As scheduled on the drawings.
 6. Body: Cast-iron or ductile-iron, with interior lining complying with AWWA C550 or that is FDA approved.
 7. End Connections: Flanged.
 8. Configuration: Designed for horizontal, straight through flow.
 9. Accessories:
 - a. Valves: Outside screw and yoke gate-type with flanged, or grooved ends on inlet and outlet.

- b. Bypass: With displacement-type water meter, shutoff valves, and double-check backflow prevention device.
 - B. Reduced-Pressure-Detector, Fire-Protection Backflow-Preventer Assemblies:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.
 - b. FEBCO; a Division of Watts Water Technologies, Inc.
 - c. Watts Water Technologies, Inc.; Ames Fire & Waterworks.
 - d. Watts Water Technologies, Inc.; Watts Regulator Co.
 - e. Zurn Plumbing Products Group; Wilkins Div.
 - 2. Standard: ASSE 1047 and Factory Mutual Global (FMG) approved or UL listed.
 - 3. Operation: Continuous-pressure applications.
 - 4. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.
 - 5. Size and Capacities: As scheduled on the drawings.
 - 6. Body: Cast-iron or ductile-iron, with interior lining complying with AWWA C550 or that is FDA approved.
 - 7. End Connections: Flanged.
 - 8. Configuration: Designed for horizontal, straight through flow.
 - 9. Accessories:
 - a. Valves: Outside screw and yoke gate-type with flanged ends on inlet and outlet.
 - b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.
 - c. Bypass: With displacement-type water meter, shutoff valves, and reduced-pressure backflow preventer.
- 2.4 SPRINKLER SPECIALTY FITTINGS
 - A. Sprinkler specialty fittings shall be UL listed or FMG approved, with 175-psig minimum working-pressure rating, and made of materials compatible with piping. Sprinkler specialty fittings shall have 300-psig working-pressure rating if fittings are components of high-pressure piping system.
 - B. Sprinkler Drain and Alarm Test Fittings: Cast-bronze or ductile-iron body; with threaded or locking-lug inlet and outlet, test valve, and orifice and sight glass.
 - 1. Manufacturers:
 - a. Tyco Fire Protection Products by Johnson Controls Company.
 - b. Fire-End and Croker Corp.
 - c. Viking Corp.
 - d. Victaulic Co. of America; Series UTD Universal Test and Drain.
 - C. Sprinkler Branch-Line Test Fittings: Brass body with threaded inlet, capped drain outlet, and threaded outlet for sprinkler.
 - 1. Manufacturers:
 - a. Elkhart Brass Mfg. Co., Inc.
 - D. Sprinkler Inspector's Test Fitting: Cast- or ductile-iron housing with threaded inlet and drain outlet and sight glass.

1. Manufacturers:
 - a. AGF Manufacturing Co.
 - b. G/J Innovations, Inc.
 - c. Triple R Specialty of Ajax, Inc.
 - d. Tyco Fire Protection Products by Johnson Controls Company.

- E. Drop-Nipple Fittings: UL 1474, adjustable with threaded inlet and outlet, and seals.
 1. Manufacturers:
 - a. CECA, LLC.
 - b. Merit.

- F. Flexible Sprinkler Drop Fittings:
 1. Manufacturers:
 - a. Victaulic Co. of America; VicFlex Sprinkler Fittings; AH-2 or AH2-CC with AB1 Bracket Assembly.
 - b. Reliable Automatic Sprinkler Co., Inc.; RASCOflex Series RFB.
 - c. FlexHead Industries, Inc.; ASC Engineered Solutions
 2. Description: UL listed and FMG approved stainless steel flexible hose for connection to sprinkler, and with bracket for connection to commercial ceiling grid.
 3. Standard: UL 2443.
 4. Pressure Rating: 175 psig minimum; 300 psig if fittings are components of high-pressure piping system.
 5. Size: Same as connected piping, for sprinkler.

2.5 LISTED FIRE-PROTECTION VALVES

- A. Valves: UL listed or FMG approved.
 1. Valves shall have 175-psig minimum pressure rating.

- B. Gate Valves with Wall Indicator Posts:
 1. Gate Valves: UL 262, cast-iron body, bronze mounted, with solid disc, nonrising stem, operating nut, and flanged ends.
 2. Manufacturers:
 - a. McWane, Inc.; Kennedy Valve Div.
 - b. NIBCO.
 - c. Crane Co.; Crane Valve Group; Stockham Valves.

- C. Ball Valves: Comply with UL 1091, except with ball instead of disc.
 1. NPS 1-1/2 and Smaller: Bronze body with threaded ends.
 2. NPS 2 and NPS 2-1/2: Bronze body with threaded ends or ductile-iron body with grooved ends.
 3. NPS 3: Ductile-iron body with grooved ends.
 4. Manufacturers:
 - a. NIBCO.

- b. Victaulic Co. of America.
- D. Butterfly Valves: UL 1091.
- 1. NPS 2-1/2 and Larger: Bronze, cast-iron, or ductile-iron body; wafer type or with flanged or grooved ends.
 - a. Manufacturers:
 - 1) McWane, Inc.; Kennedy Valve Div.
 - 2) Mueller Company; ASC Engineered Solutions.
 - 3) NIBCO.
 - 4) Tyco Fire Protection Products by Johnson Controls Company.
 - 5) Victaulic Co. of America; Series 705.
- E. Check Valves NPS 2 and Larger: UL 312, swing type, cast-iron body with flanged or grooved ends.
- 1. Manufacturers:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Valves.
 - d. Hammond Valve.
 - e. McWane, Inc.; Kennedy Valve Div.
 - f. Mueller Company; ASC Engineered Solutions.
 - g. NIBCO.
 - h. Tyco Fire Protection Products by Johnson Controls.
 - i. Victaulic Co. of America.
 - j. Watts Water Technologies, Inc.; Watts Regulator Co.
- F. Gate Valves: UL 262, OS&Y type.
- 1. NPS 2 and Smaller: Bronze body with threaded ends.
 - a. Manufacturers:
 - 1) Crane Co.; Crane Valve Group; Crane Valves.
 - 2) Hammond Valve.
 - 3) NIBCO.
 - 2. NPS 2-1/2 and Larger: Cast or ductile -iron body with flanged or grooved ends.
 - a. Manufacturers:
 - 1) McWane, Inc.; Clow Valve Co.
 - 2) Crane Co.; Crane Valve Group; Crane Valves.
 - 3) Crane Co.; Crane Valve Group; Jenkins Valves.
 - 4) Hammond Valve.
 - 5) Milwaukee Valve Company.
 - 6) Mueller Company.
 - 7) NIBCO.
 - 8) Victaulic Co. of America: Series 771.

2.6 UNLISTED GENERAL-DUTY VALVES

- A. Ball Valves NPS 2 and Smaller: MSS SP-110, 2-piece copper-alloy body with chrome-plated brass ball, 600-psig minimum CWP rating, blowout-proof stem, and threaded ends.
- B. Check Valves NPS 2 and Smaller: MSS SP-80, Type 4, Class 125 minimum, swing type with bronze body, nonmetallic disc, and threaded ends.
- C. Gate Valves NPS 2 and Smaller: MSS SP-80, Type 2, Class 125 minimum, with bronze body, solid wedge, and threaded ends.
- D. Globe Valves NPS 2 and Smaller: MSS SP-80, Type 2, Class 125 minimum, with bronze body, nonmetallic disc, and threaded ends.

2.7 ALARM CHECK VALVES

- A. General Requirements:
 - 1. Standard: UL listed or FMG approved.
 - 2. Pressure Rating:
 - a. Standard-Pressure Valves: 175 psig minimum.
 - b. High-Pressure Valves: 300 psig.
 - 3. Body Material: Cast or ductile iron.
 - 4. Size: Same as connected piping.
 - 5. End Connections: Flanged or grooved.
- B. Manufacturers:
 - 1. Reliable Automatic Sprinkler Co., Inc.
 - 2. Tyco Fire Protection Products by Johnson Controls Company.
 - 3. Viking Corp.
 - 4. Victaulic Co. of America.
- C. Description: UL 193, designed for horizontal or vertical installation, with bronze grooved seat with O-ring seals, single-hinge pin, and latch design. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, and fill-line attachment with strainer.
 - 1. Drip Cup Assembly: Pipe drain without valves and separate from main drain piping.
 - 2. Drip Cup Assembly: Pipe drain with check valve to main drain piping.

2.8 AUTOMATIC (BALL DRIP) DRAIN VALVES

- A. General:
 - 1. Standard: UL 1726.
 - 2. Pressure Rating: 175 psig minimum.
 - 3. Type: Automatic draining, ball check.
 - 4. Size: NPS 3/4.
 - 5. End Connections: Threaded.

B. Manufacturer:

1. Reliable Automatic Sprinkler Co., Inc.
2. Tyco Fire Protection Products by Johnson Controls Company.

2.9 SPRINKLERS

A. Sprinklers shall be UL listed or FMG approved, with 175-psig minimum pressure rating. Sprinklers shall have 300-psig pressure rating if sprinklers are components of high-pressure piping system.

B. Manufacturers:

1. Reliable Automatic Sprinkler Co., Inc.
2. Tyco Fire Protection Products by Johnson Controls Company.
3. Victaulic Co. of America.
4. Viking Corp.

C. Automatic Sprinklers:

1. With heat-responsive glass bulb element complying with the following:

- a. UL 199, for nonresidential applications.
- b. UL 1626, for residential applications.
- c. UL 1767, for early-suppression, fast-response applications.

2. Open Sprinklers: UL 199, without heat-responsive element.

- a. Orifice: 1/2 inch, with discharge coefficient K between 5.3 and 5.8.
- b. Orifice: 17/32 inch, with discharge coefficient K between 7.4 and 8.2.

D. Sprinkler Types and Categories: Nominal 1/2-inch orifice for 165 deg F "Ordinary" temperature classification rating, unless otherwise indicated or required by application.

E. Sprinkler types, features, and options as follows:

1. Concealed ceiling sprinklers, including cover plate.
2. Extended-coverage sprinklers.
3. Flush ceiling sprinklers, including escutcheon.
4. Pendent sprinklers.
5. Pendent, dry-type sprinklers.
6. Quick-response sprinklers.
7. Recessed sprinklers, including escutcheon.
8. Concealed sidewall sprinklers, including cover plate.
9. Upright sprinklers.

F. Sprinkler Finishes: Chrome plated, bronze, and painted.

G. Special Coatings: Wax, lead, and corrosion-resistant paint.

H. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers. Escutcheons listed, supplied, and approved for use with the sprinkler by the sprinkler manufacturer.

1. Ceiling Mounting: Chrome-plated steel, 2 piece, with 3/4-inch vertical adjustment.
 2. Sidewall Mounting: Chrome-plated steel, one piece, flat.
- I. Sprinkler Guards: Wire-cage type, including fastening device for attaching to sprinkler. Sprinkler guards listed, supplied, and approved for use with the sprinkler by the sprinkler manufacturer.

2.10 HOSE CONNECTIONS

A. Manufacturers:

1. Elkhart Brass Mfg. Co., Inc.
2. FPPI (Fire Protection Products, Inc.); ASC Engineered Solutions.
3. Potter Roemer Fire Pro; A Member of Morris Group International.

- B. Description: UL 668, brass or bronze, 300-psig minimum pressure rating, hose valve for connecting fire hose. Include angle or gate pattern design; female NPS inlet and male hose outlet; and lugged cap, gasket, and chain. Include NPS 1-1/2 or NPS 2-1/2 as indicated, and hose valve threads according to NFPA 1963 and matching local fire department threads.

1. Valve Operation: Nonadjustable type.
2. Finish: Rough metal or chrome-plated

2.11 FIRE DEPARTMENT CONNECTIONS

A. Manufacturers:

1. Elkhart Brass Mfg. Co., Inc.
2. Potter Roemer Fire Pro; A Member of Morris Group International.

- B. Exposed, Freestanding-Type, Fire Department Connection: UL 405, **300-psig** pressure rating; with corrosion-resistant-metal body, brass inlets with threads according to NFPA 1963 and matching local fire department sizes and threads, and bottom outlet with pipe threads. Include brass lugged caps, gaskets, and brass chains; brass lugged swivel connection and drop clapper for each hose-connection inlet; 18-inch- high, brass sleeve; and round, floor, brass escutcheon plate with marking "AUTO SPKR & STANDPIPE."

1. Finish Including Sleeve: Polished chrome-plated.

2.12 ALARM DEVICES

- A. Alarm-device types shall match piping and equipment connections.

- B. Water-Motor-Operated Alarm: UL 753, mechanical-operation type with pelton-wheel operator with shaft length, bearings, and sleeve to suit wall construction and 10-inch-diameter, cast-aluminum alarm gong with red-enamel factory finish. Include NPS 3/4 inlet and NPS 1 drain connections.

1. Manufacturers:
 - a. AFAC Inc.

- b. Firematic Sprinkler Devices, Inc.
 - c. Reliable Automatic Sprinkler Co., Inc.
 - d. Tyco Fire Protection Products by Johnson Controls Company.
 - e. Viking Corp.

- C. Electrically Operated Alarm: UL 464, with 6-inch- minimum- 10-inch diameter, vibrating-type, metal alarm bell with red-enamel factory finish and suitable for outdoor use.
 - 1. Manufacturers:
 - a. Potter Electric Signal Company, LLC.
 - b. System Sensor.

- D. Water-Flow Indicator: UL 346, electrical-supervision, paddle-operated-type, water-flow detector with 250-psig pressure rating and designed for horizontal or vertical installation. Include two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
 - 1. Manufacturers:
 - a. Potter Electric Signal Company, LLC.
 - b. System Sensor.

- E. Pressure Switch: UL 753, electrical-supervision-type, water-flow switch with retard feature. Include single-pole, double-throw, normally closed contacts and design that operates on rising pressure and signals water flow.
 - 1. Manufacturers:
 - a. Potter Electric Signal Company, LLC.
 - b. System Sensor.

- F. Valve Supervisory Switch: UL 753, electrical, single-pole, double-throw switch with normally closed contacts. Include design that signals controlled valve is in other than fully open position.
 - 1. Manufacturers:
 - a. Potter Electric Signal Company, LLC.
 - b. System Sensor.

- G. Indicator-Post Supervisory Switch: UL 753, electrical, single-pole, double-throw switch with normally closed contacts. Include design that signals controlled indicator-post valve is in other than fully open position.
 - 1. Manufacturers:
 - a. Potter Electric Signal Company, LLC.
 - b. System Sensor.

2.13 PRESSURE GAGES

- A. Manufacturers:

1. AMETEK, Inc.; U.S. Gauge.
 2. Ashcroft Inc.
 3. Marsh Bellofram.
 4. Viking Corp.
 5. Weiss Instruments, Inc.
- B. Description: UL 393, 3-1/2- to 4-1/2-inch- diameter, dial pressure gage with range of 0 to 250 psig minimum .
1. Water System Piping: Include caption "WATER" or "AIR/WATER" on dial face.
 2. Air System Piping: Include caption "AIR" or "AIR/WATER" on dial face.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in Part 1 "Quality Assurance" Article.
- B. Report test results promptly and in writing.

3.2 EARTHWORK

- A. Refer to Division 31 Section "Earthwork" for excavating, trenching, and backfilling.

3.3 EXAMINATION

- A. Examine roughing-in for hose connections and stations to verify actual locations of piping connections before installation.
- B. Examine walls and partitions for suitable thicknesses, fire- and smoke-rated construction, framing for hose-station cabinets, and other conditions where hose connections and stations are to be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.4 PIPING APPLICATIONS, GENERAL

- A. Flanges, flanged fittings, unions, nipples, grooved-joint couplings, and transition and special fittings with finish and pressure ratings same as or higher than system's pressure rating may be used in aboveground applications, unless otherwise indicated.
- B. Piping between Fire Department Connections and Check Valves: Galvanized, standard-weight steel pipe with threaded ends; cast- or malleable-iron threaded fittings; and threaded joints; or grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.
- C. Underground Service-Entrance Piping: Ductile-iron, push-on or mechanical-joint pipe and fittings and restrained joints.

3.5 SPRINKLER RISER AND STANDPIPE SYSTEM PIPING APPLICATIONS

A. Sprinkler Risers and Standpipes: Use the following:

Pipe Type	4" & Smaller	5" & 6"	8" - 12"
Standard weight steel, threaded fittings	YES	YES	NO
Standard weight steel, grooved fittings	YES	YES	YES
Standard weight steel, welded fittings	YES	YES	YES

3.6 SPRINKLER SYSTEM PIPING APPLICATIONS

A. Wet-Pipe Sprinklers: Use the following:

Pipe Type	1 ½" & Smaller	2"	2 ½" - 3 ½"	4"	5" - 6"
Standard weight steel, threaded fittings	YES	YES	YES	YES	NO
Standard weight steel, grooved fittings	NO	NO	YES	YES	YES
Standard weight steel, welded fittings	NO	YES	YES	YES	YES

3.7 VALVE APPLICATIONS

A. The following requirements apply:

1. Listed Fire-Protection Valves: UL listed or FMG approved for applications where required by NFPA 13.
 - a. Shutoff Duty: Use ball, butterfly, or gate valves.
2. Unlisted General-Duty Valves: For applications where UL-listed and FMG-approved valves are not required by NFPA 13.
 - a. Shutoff Duty: Use ball, butterfly, or gate valves.
 - b. Throttling Duty: Use ball or globe valves.

3.8 JOINT CONSTRUCTION

- A. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.
- B. Threaded Joints: Comply with NFPA 13 for pipe thickness and threads. Do not thread pipe smaller than NPS 8 with wall thickness less than Schedule 40 unless approved by authorities having jurisdiction and threads are checked by a ring gage and comply with ASME B1.20.1.
- C. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
 1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.

- D. Use of saddle style tees is not acceptable.
- E. Grooved Joints: Assemble joints with listed coupling and gasket, lubricant, and bolts.
 - 1. All grooved couplings, fittings, gaskets, valves, and specialties shall be the product of a single manufacturer.
 - 2. Steel Pipe: Square-cut or roll-groove piping as indicated. Use grooved-end fittings and rigid, grooved-end-pipe couplings, unless otherwise indicated.
- F. Dissimilar-Metal Piping Joints: Construct joints using dielectric fittings compatible with both piping materials. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for additional requirements.

3.9 SERVICE-ENTRANCE PIPING

- A. Connect fire-suppression piping to water-service piping of size and in location indicated for service entrance to building. Refer to Division 33 Section "Water Distribution" for exterior piping.
- B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-service piping.
- C. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.

3.10 WATER-SUPPLY CONNECTION

- A. Connect fire-suppression piping to building's interior water distribution piping.
- B. Install shutoff valve, backflow prevention device, pressure gage, drain, and other accessories indicated at connection to water distribution piping.
- C. Install shutoff valve, check valve, pressure gage, and drain at connection to water supply.

3.11 PIPING INSTALLATION

- A. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for basic piping installation.
- B. Install underground ductile-iron service-entrance piping according to NFPA 24 and with restrained joints.
- C. Use approved fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- D. Install unions adjacent to each valve in pipes NPS 2 and smaller. Unions are not required on flanged devices or in piping installations using grooved joints.
- E. Install flanges or flange adapters on valves, apparatus, and equipment having NPS 2-1/2 and larger connections.
- F. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, sized and located according to NFPA 13.

- G. Install sprinkler piping with drains for complete system drainage.
- H. Install sprinkler zone control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
- I. Install drain valves on standpipes.
- J. Install ball drip valves to drain piping between fire department connections and check valves. Drain to floor drain or outside building.
- K. Install alarm devices in piping systems.
- L. Hangers and Supports: Comply with NFPA 13 for hanger materials.
 - 1. Install standpipe system piping according to NFPA 14.
 - 2. Install sprinkler system piping according to NFPA 13, except use of "C" clamps, or beam clamps of "C" pattern, or any modification thereof, is prohibited for supporting pipes larger than NPS 2-1/2.
 - 3. Refer to Division 20 Section "Hangers and Supports" for additional requirements.
- M. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.
- N. Fill wet-standpipe system piping with water.
- O. Fill wet-pipe sprinkler system piping with water.
- P. Install cover system, brackets, and cover components for sprinkler piping according to manufacturer's "Installation Manual" and with NFPA 13 or NFPA 13R for supports.

3.12 VALVE INSTALLATION

- A. Install listed fire-protection valves, unlisted general-duty valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
- B. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Valves for Wall-Type Fire Hydrants: Install nonrising-stem gate valve in water-supply pipe.
- D. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water supply sources.
- E. Specialty Valves:
 - 1. Alarm Check Valves: Install in vertical position for proper direction of flow, including bypass check valve and retarding chamber drain-line connection.
 - 2. Dry-Pipe Valves: Install trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.

- a. Air-Pressure Maintenance Devices for Dry-Pipe Systems: Install shutoff valves to permit servicing without shutting down sprinkler system; bypass valve for quick system filling; pressure regulator or switch to maintain system pressure; strainer; pressure ratings with 14- to 60-psig adjustable range; and 175-psig maximum inlet pressure.
- b. Install air compressor and compressed-air supply piping.

3.13 SPRINKLER APPLICATIONS

A. Use the following sprinkler types:

1. Rooms without Ceilings: Upright sprinklers.
2. Rooms with Suspended Ceilings: Concealed sprinklers.
3. Wall Mounting: Sidewall sprinklers.
4. Sprinkler Finishes:
 - a. Upright, Pendent, and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes; white polyester finish in natatoriums.
 - b. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
 - c. Flush Sprinklers: Bright chrome, with painted white escutcheon.
 - d. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
5. Sprinkler Guards: For exposed sprinkler heads subject to damage.

3.14 SPRINKLER INSTALLATION

- #### A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels and tiles.

3.15 HOSE-CONNECTION INSTALLATION

- A. Install hose connections adjacent to standpipes, unless otherwise indicated.
- B. Install freestanding hose connections for access and minimum passage restriction.
- C. Install NPS 1-1/2 hose-connection valves with flow-restricting device, unless otherwise indicated.
- D. Install NPS 2-1/2 hose connections with quick-disconnect NPS 2-1/2 by NPS 1-1/2 reducer adapter and flow-restricting device, unless otherwise indicated.
- E. Install wall-mounting-type hose connections in cabinets. Include pipe escutcheons, with finish matching valves, inside cabinet where water-supply piping penetrates cabinet. Install valves at angle required for connection of fire hose. Refer to Division 10 Section "Fire-Protection Specialties" for cabinets.

3.16 FIRE DEPARTMENT CONNECTION INSTALLATION

- A. Install wall-type, fire department connections in vertical wall.
- B. Install ball drip valve at each check valve for fire department connection.

3.17 CONNECTIONS

- A. Install piping adjacent to equipment to allow service and maintenance.
- B. Connect water-supply piping to fire-suppression piping. Include backflow preventer between potable-water piping and fire-suppression piping. Refer to Division 22 Section "Domestic Water Piping Specialties" for backflow preventers.
- C. Install ball drip valves at each check valve for fire department connection. Drain to floor drain or outside building.
- D. Connect piping to specialty valves, hose valves, specialties, fire department connections, and accessories.
- E. Connect excess-pressure pumps to the following piping and wiring:
 - 1. Sprinkler system, hydraulically.
 - 2. Pressure gages and controls, hydraulically.
 - 3. Electrical power system.
 - 4. Alarm device accessories for pump.
 - 5. Fire alarm.
- F. Connect compressed-air supply to dry-pipe sprinkler piping.
- G. Connect air compressor to the following piping and wiring:
 - 1. Pressure gages and controls.
 - 2. Electrical power system.
 - 3. Fire alarm devices, including low-pressure alarm.
- H. Electrical Connections: Power wiring and fire alarm wiring are specified in Division 26.
- I. Connect alarm devices to fire alarm.
- J. Ground equipment according to Division 26 Section "Grounding and Bonding."
- K. Connect wiring according to Division 26 Section "Conductors and Cables."
- L. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.18 LABELING AND IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13 and in Division 20 Section "Mechanical Identification."

3.19 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
 4. Flush, test, and inspect standpipe systems according to NFPA 14, "System Acceptance" Chapter.
 5. Verify that equipment hose threads are same as local fire department equipment.
 6. Test each backflow prevention device according to authorities having jurisdiction and the device's reference standard.
- B. Verify that specialty valves, trim, fittings, controls, and accessories are installed and operate correctly.
 - C. Verify that specified tests of piping are complete.
 - D. Verify that damaged sprinklers and sprinklers with paint or coating not specified are replaced with new, correct type.
 - E. Verify that sprinklers are correct types, have correct finishes and temperature ratings, and have guards as required for each application.
 - F. Verify that potable-water supplies have correct types of backflow preventers.
 - G. Coordinate with fire alarm tests. Operate as required.
 - H. Coordinate with fire-pump tests. Operate as required.
 - I. Report test results promptly and in writing to Architect and authorities having jurisdiction.
- 3.20 CLEANING AND PROTECTION
- A. Clean dirt and debris from sprinklers.
 - B. Remove and replace sprinklers with paint other than factory finish.
 - C. Protect sprinklers from damage until Substantial Completion.
- 3.21 DEMONSTRATION
- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.

END OF SECTION 211100

SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical Identification" for valve tags and charts.
 - 2. Division 21 Fire-Suppression Piping and Fire Pump Sections for fire-protection valves.
 - 3. Division 22 Piping Sections for specialty valves applicable to those Sections only.
 - 4. Division 23 Section "General-Duty Valves for HVAC" for HVAC.
 - 5. Division 23 Section "Temperature Controls" for control valves and actuators.

1.2 SUMMARY

- A. This Section includes valves for general plumbing applications. Refer to piping Sections for specialty valve applications.

1.3 DEFINITIONS

- A. The following are standard abbreviations for valves:

1. CWP: Cold working pressure.
2. EPDM: Ethylene-propylene-diene terpolymer rubber.
3. NBR: Acrylonitrile-butadiene rubber.
4. NRS: Nonrising stem.
5. OS&Y: Outside screw and yoke.
6. PTFE: Polytetrafluoroethylene plastic.
7. RPTFE: Reinforced polytetrafluoroethylene plastic.
8. SWP: Steam working pressure.
9. TFE: Tetrafluoroethylene plastic.
10. WOG: Water, oil, and gas.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating valve and its application. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.
 1. Certification that products for use in potable water systems comply with NSF 61 and NSF 372.

1.5 QUALITY ASSURANCE

- A. ASME Compliance for Ferrous Valves: ASME B16.10 and ASME B16.34 for dimension and design criteria.
- B. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of Lead in Drinking Water Act," about lead content in materials that will be in contact with potable water for human consumption.
- C. NSF Compliance: NSF 61 and NSF 372 for valve materials for potable-water service.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 1. Protect internal parts against rust and corrosion.
 2. Protect threads, flange faces, grooves, and weld ends.
 3. Set angle, gate, and globe valves closed to prevent rattling.
 4. Set ball and plug valves open to minimize exposure of functional surfaces.
 5. Set butterfly valves closed or slightly open.
 6. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
 1. Maintain valve end protection.
 2. Store valves indoors and maintain at higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 VALVES, GENERAL

- A. Isolation valves are scheduled on the Drawings. For other general plumbing valve applications, use the following:
 - 1. Shutoff Service: Ball, butterfly valves.
 - 2. Throttling Service: Angle, ball, butterfly, or globe valves.
 - 3. Pump Discharge: Spring-loaded, lift-disc check valves; and bronze lift check valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.
- D. For valves not indicated in the Application Schedules, select valves with the following end connections:
 - 1. For Copper Tubing, NPS 2 and Smaller: Solder-joint or threaded ends, except provide valves with threaded ends for condenser water, heating hot water, steam, and steam condensate services.
 - 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged, solder-joint, or threaded ends.
 - 3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
 - 4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
 - 5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends.
 - 6. For Steel Piping, NPS 5 and Larger: Flanged ends.
 - 7. For Grooved-End Systems: Valve ends may be grooved.
- E. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted unless otherwise noted.
- F. Wetted surfaces of valves contacted by consumable water shall contain not more than 0.25 percent weighted average lead content.
 - 1. Exceptions:
 - a. Valves in pumped sanitary systems.
 - b. Valves in pumped storm systems.
 - c. Drain valves.
 - d. Valves in general air or vacuum systems.
 - e. Valves in irrigation systems.
 - f. Valves in non-potable water systems.
 - g. Valves in other plumbing systems not intended for human consumption.
- G. Valve Sizes: Same as upstream pipe, unless otherwise indicated.
- H. Valve Actuators:
 - 1. Chainwheel: For attachment to valves, of size and mounting height, as indicated in the "Valve Installation" Article in Part 3.
 - 2. Gear Drive Operator: For quarter-turn valves NPS 8 and larger.
 - 3. Handwheel: For valves other than quarter-turn types.
 - 4. Lever Handle: For quarter-turn valves NPS 6 and smaller.

- I. Extended Valve Stems: On insulated valves.
- J. Valve Flanges: ASME B16.1 for cast-iron valves, ASME B16.5 for steel valves, and ASME B16.24 for bronze valves.
- K. Threaded: With threads according to ASME B1.20.1.
- L. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE BALL VALVES

- A. Bronze Ball Valves, General: MSS SP-110 and have bronze body complying with ASTM B 584, except for Class 250 which shall comply with ASTM B 61, full-depth ASME B1.20.1 threaded or solder ends, and blowout-proof stems.
- B. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim: Type 316 stainless-steel ball and stem, reinforced TFE seats, blow-out-proof stem, with adjustable stem packing, soldered or threaded ends; 150 psig SWP and 600-psig CWP ratings.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; by Conbraco Industries, Inc.; Series 77CLF-A Series.
 - b. Hammond Valve.
 - c. Kitz Corporation; Kitz Valves.
 - d. Milwaukee Valve Company; UPBA400S/450S.
 - e. NIBCO INC.; Models S-585-70-66-LF/T-585-70-66-LF.
 - f. Watts Water Technologies, Inc.; Series LFB6080G2/LFB6081G2.

2.3 GENERAL SERVICE BUTTERFLY VALVES

- A. General: MSS SP-67, for bubble-tight shutoff, extended-neck for insulation, disc and lining suitable for potable water, unless otherwise indicated, and with the following features:
 - 1. Full lug, and grooved valves shall be suitable for bi-directional dead end service at full rated pressure without the use or need of a downstream flange.
 - 2. Valve sizes NPS 2 through NPS 6 shall have lever lock operator; valve sizes NPS 8 and larger shall have weatherproof gear operator.
- B. Lug-Style (Single-Flange) Size NPS 2-1/2 through NPS 12, 200-psig CWP Rating, Aluminum-Bronze Disc, EPDM Seat, Ferrous-Alloy Butterfly Valves: Full-lug type with ductile-iron body, Type 416 stainless-steel stem, copper bushing, aluminum-bronze disc, and molded-in EPDM seat (liner).
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; by Conbraco Industries, Inc.; Series 143 and Series LD145.
 - b. Bray International, Inc.
 - c. DeZurik.
 - d. Emerson Automation Solutions; Keystone.
 - e. Forum Energy Technologies; ABZ Valve.
 - f. Hammond Valve.
 - g. Milwaukee Valve Company.

- h. NIBCO INC.; LD-2000-3/5.
- i. Tyco Flow Control; Grinnell Flow Control.
- j. Watts Water Technologies.

2.4 BRONZE CHECK VALVES

- A. Bronze Check Valves, General: MSS SP-80.
- B. Class 125, Bronze, Swing Check Valves with Bronze Disc: ASTM B-62 bronze body and seat with regrinding-type bronze disc, Y-pattern design, soldered or threaded end connections, and having 200 psig CWP rating.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; by Conbraco Industries, Inc.; Model 162T-LF and 163T-LF (61YLF Series).
 - b. Milwaukee Valve Company; Model UP509/UP1509.
 - c. NIBCO INC.; Models S-413-B-LF or T-413-B-LF.
 - d. Watts Water Technologies; LFCVY/LFCVYS.

2.5 IRON SWING CHECK VALVES

- A. Iron Swing Check Valves, General: MSS SP-71.
- B. Class 125, Gray-Iron, Standard Swing Check Valves: ASTM A-126, Class B cast-iron body and bolted bonnet with flanged end connections; non-asbestos synthetic-fiber gaskets; bronze disc and seat; and having 200 psig CWP rating.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; by Conbraco Industries, Inc.; Model 910F.
 - b. Crane Co.; Crane Valves.
 - c. Crane Co.; Stockham Div.
 - d. Hammond Valve; IR1124-HI.
 - e. Milwaukee Valve Company; Model F-2974.
 - f. NIBCO INC.; Model F-918-B.
 - g. Watts Water Technologies.

2.6 LIFT CHECK VALVES

- A. Class 125, Lift Check Valves with Nonmetallic Disc:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; by Conbraco Industries, Inc.; Model CBV-LF (61LF Series).
 - b. Bonomi USA, Inc.; Series 100002 and 100003.
 - c. Hammond Valve; UP943 and UP947.
 - d. Milwaukee Valve Company; UP548T and UP1548T.
 - e. NIBCO INC.; Model S-480-Y-LF and T-480-Y-LF.
 - f. Watts Water Technologies; LF600.

2. Description:

- a. Standard: MSS SP-80, Type 2.
- b. CWP Rating: 250 psig.
- c. Body Design: Vertical flow.
- d. Body Material: Lead free brass or bronze.
- e. Ends: Threaded or Solder.
- f. Disc: PTFE, TFE, or Polyetherimide.

2.7 SPRING-LOADED, CENTER-GUIDED LIFT-DISC (SILENT) CHECK VALVES

- A. Lift-Disc Check Valves, General: FCI 74-1 and MIL-V-18436F, with spring-loaded, center-guided bronze disc and seat.
- B. Class 125, Wafer, Lift-Disc Check Valves: Wafer style with cast-iron body with diameter made to fit within bolt circle, and having 200 psig CWP rating.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. NIBCO INC.; Model W-910-B-LF.
 - b. Mueller Steam Specialty.
 - c. Milwaukee Valve Company.
 - d. Hammond Valve.
- C. Class 125, Globe, Flanged Lift-Disc Check Valves: Globe style with cast-iron body and flanged ends and having 200 psig CWP rating.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. NIBCO INC.; Model F-910-B-LF.
 - b. Mueller Steam Specialty.
 - c. Milwaukee Valve Company.
 - d. Hammond Valve.

2.8 BRONZE GLOBE VALVES

- A. Bronze Globe Valves, General: MSS SP-80, with malleable-iron handwheel.
- B. Class 125, TFE Disc, Bronze Globe Valves: ASTM B-62 bronze body, bonnet, and seat, TFE disc, copper-silicone bronze stem, union-ring bonnet, soldered or threaded end connections; and having 200 psig CWP rating.
 - 1. Manufacturers: Subject to compliance with requirements, Provide products by one of the following:
 - a. Apollo Valves; by Conbraco Industries, Inc.; Model 121T-LF.
 - b. Hammond Valve; UP418 and UP440.
 - c. Milwaukee Valve Company; Model UP502 and UP1502.
 - d. Watts Water Technologies, Inc.; LFGLV.

2.9 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:

1. Bronze ball valve as specified in this Section. Lead free construction is not required.
2. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.10 CHAINWHEEL ACTUATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Babbitt Steam Specialty Co.
2. Roto Hammer Industries, Inc.

B. Description: Valve actuation assembly with sprocket rim, brackets, and chain.

C. Identification: Factory label or color coding to identify lead free valves.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

C. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

D. Examine threads on valve and mating pipe for form and cleanliness.

E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

F. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Piping installation requirements are specified in other Division 20 and 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

- B. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- C. Locate valves for easy access and provide separate support where necessary.
- D. Install valves in horizontal piping with stem at or above center of pipe. Butterfly valves shall be installed with stem horizontal to allow support for the disc and the cleaning action of the disc.
- E. Install valves in position to allow full stem movement.
- F. Install check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level.
 - 2. Lift Check Valves: With stem upright and plumb.

3.3 JOINT CONSTRUCTION

- A. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.

3.4 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

END OF SECTION 220523

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods" for materials and methods common to mechanical piping systems.
 - 3. Division 20 Section "Hangers and Supports."
 - 4. Division 20 Section "Meters and Gages" for thermometers, pressure gages, and fittings.
 - 5. Division 22 Section "General-Duty Valves for Plumbing."
 - 6. Division 22 Section "Domestic Water Piping Specialties" for water distribution piping specialties.

1.2 SUMMARY

- A. This Section includes domestic water piping and water meters inside the building.

- B. Water meters will be furnished by utility company for installation by Contractor.

1.3 PERFORMANCE REQUIREMENTS

- A. Where not indicated on the Drawings, provide components and installation capable of producing domestic water piping systems with 125 psig, unless otherwise indicated.
 - 1. Exception: PEX plastic piping insert fittings specified are limited to 100 psig.

1.4 SYSTEMS DESCRIPTION

- A. Potable and non-potable domestic water piping system materials are scheduled on the Drawing.
- B. Under-Building-Slab, Water-Service Piping on Service Side of Water Meter: Refer to Division 22 Section "Facility Water Distribution."
- C. Refer to Application Schedules on the Drawings for valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - 1. Hot-Water-Piping, Balancing Duty: Calibrated balancing valves.
 - 2. Drain Duty: Hose-end drain valves.
 - 3. Isolation Valves at Domestic Water Meters: Gate Valves, NPS 2 and Smaller: Class 150, bronze.
 - 4. Isolation Valves at Domestic Water Meters: Gate Valves, NPS 2-1/2 and Larger: Class 125, OS&Y, bronze-mounted cast iron.
- D. Transition and special fittings with pressure ratings at least equal to piping rating may be used unless otherwise indicated.

1.5 ACTION SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings and water meters.

1.6 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: For piping in equipment rooms and other congested areas, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
 - 1. Fire-suppression-water piping.
 - 2. Domestic water piping.
 - 3. HVAC hydronic piping.

1.7 CLOSEOUT SUBMITTALS

- A. Field quality-control test reports.
- B. Water Samples: Specified in Part 3 "Cleaning" Article.

1.8 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of Lead in Drinking Water Act," about lead content in materials that will be in contact with potable water for human consumption.
- C. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," and NSF 372 Drinking Water System Components - Lead Content for potable domestic water piping and components.

1.9 PROJECT CONDITIONS

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
 - 1. Notify Construction Manager no fewer than two days in advance of proposed interruption of water service.
 - 2. Do not proceed with interruption of water service without Construction Manager's written permission.

1.10 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 PIPING MATERIALS

- A. Transition Couplings for Aboveground Pressure Piping: Coupling or other manufactured fitting the same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

2.3 COPPER TUBE AND FITTINGS

- A. Soft Copper Tube: ASTM B 88, Type K, water tube, annealed temper.
 - 1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.

2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends. Furnish Class 300 flanges if required to match piping.
3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

B. Hard Copper Tube: ASTM B 88, Type L, water tube, drawn temper.

1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought- copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends. Furnish Class 300 flanges if required to match piping.
3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

2.4 VALVES

- A. General-duty plumbing valves; and drain valves are specified in Division 22 Section "Plumbing Valves."
- B. Balancing valves are specified in Division 22 Section "Domestic Water Piping Specialties."

2.5 WATER METERS

- A. Refer to Division 20 Section "Mechanical General Requirements."
- B. Displacement-Type Water Meters NPS 2 and Smaller: AWWA C700, nutating-disc totalization meter with bronze case and 150-psig minimum working-pressure rating; with registration in gallons or cubic feet as required by utility; and with threaded end connections.
 1. Manufacturers:
 - a. AALIANT; a Venture Measurement Product Line; Niagara.
 - b. Badger Meter, Inc.
 - c. Sensus Metering Systems Inc.
- C. Turbine-Type Water Meters: AWWA C701, totalization meter with 150-psig minimum working-pressure rating; with registration in gallons or cubic feet as required by utility; and with the following end connections:
 1. NPS 2 and Smaller: Threaded.
 2. NPS 2-1/2 and Larger: Flanged.
 3. Manufacturers:
 - a. AALIANT; a Venture Measurement Product Line; Niagara.
 - b. Badger Meter, Inc.
 - c. Sensus Metering Systems Inc.
- D. Compound-Type Water Meters NPS 3 and Larger: AWWA C702, totalization meter with integral main-line and bypass meters, bronze case, and 150-psig minimum working-pressure rating; with registration in gallons or cubic feet as required by utility; and with flanged end connections.

1. Manufacturers:
 - a. Badger Meter, Inc.
 - b. Sensus Metering Systems Inc.
 - c. Kent/AMCO.

PART 3 - EXECUTION

3.1 EXCAVATION

- A. Excavating, trenching, and backfilling are specified in Division 31 Section "Earthwork."

3.2 PIPING SYSTEM INSTALLATION

- A. Basic piping installation requirements are specified in Division 20 Section "Basic Mechanical Materials and Methods."
- B. Install under-building-slab copper tubing according to Copper Development Association's "Copper Tube Handbook." Joints under slab are not allowed. Install PVC sleeve where piping penetrates slab.
- C. Install sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 20 Section "Basic Mechanical Materials and Methods."
- D. Install wall penetration system at each service pipe penetration through foundation wall. Make installation watertight. Wall penetration systems are specified in Division 20 Section "Basic Mechanical Materials and Methods."
- E. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance. Pressure gages are specified in Division 20 Section "Meters and Gages," and strainers are specified in Division 22 Section "Domestic Water Piping Specialties."
- F. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops.
- G. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping.
 1. Install hose-end drain valves at low points in water mains, risers, and branches.
 2. Install stop-and-waste drain valves where indicated.
- H. Install calibrated balancing valves in each hot-water circulation return branch and discharge side of each pump and circulator. Set calibrated balancing valves partly open to restrict but not stop flow. Calibrated balancing valves are specified in Division 22 Section "Domestic Water Piping Specialties."
- I. Install domestic water piping level without pitch and plumb.

3.3 JOINT CONSTRUCTION

- A. Basic piping joint construction requirements are specified in Division 20 Section "Basic Mechanical Materials and Methods."
- B. Water meters will be furnished and installed by utility company.
- C. Rough-in domestic water piping for water meter installation and install water meters according to utility company's requirements.
- D. Install water meters according to AWWA M6 and utility's requirements.
 - 1. Install displacement-type water meters with shutoff valve on water-meter inlet. Install valve on water-meter outlet and valved bypass around meter unless prohibited by authorities having jurisdiction.
 - 2. Install turbine-type water meters with shutoff valve on water-meter inlet. Install valve on water-meter outlet and valved bypass around meter unless prohibited by authorities having jurisdiction.
 - 3. Install compound-type water meters with shutoff valves on water-meter inlet and outlet and on valved bypass around meter. Support meters, valves, and piping on brick or concrete piers.
 - 4. Install fire-service water meters with shutoff valves on water-meter inlet and outlet and on full-size valved bypass around meter. Support meter, valves, and piping on brick or concrete piers.
 - 5. Install remote registration system according to standards of utility and of authorities having jurisdiction.

3.4 HANGER AND SUPPORT INSTALLATION

- A. Pipe hanger and support devices are specified in Division 20 Section "Hangers and Supports." Install the following:
 - 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs: According to the following:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer than 100 Feet: MSS Type 49, spring cushion rolls, if indicated.
 - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Install supports according to Division 20 Section "Hangers and Supports."
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced 1 size for double-rod hangers, to a minimum of 3/8 inch.
- E. Install hangers for drawn-temper copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 3/4 and Smaller: 60-inches with 3/8-inch rod.
 - 2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
 - 3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
 - 4. NPS 2-1/2: 108 inches with 1/2-inch rod.

5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
 6. NPS 6: 10 feet with 5/8-inch rod.
 7. NPS 8: 10 feet with 3/4-inch rod.
- F. Install supports for vertical copper tubing every 10 feet.
- G. Soft copper tube: Continuous support using v-shaped plastic pipe channel, maximum hanger spacing 8 feet with 3/8-inch rod.
- H. Alternate support for copper tubing NPS 3/4 and smaller: Continuous support using v-shaped plastic pipe channel, maximum hanger spacing 8 feet with 3/8-inch rod.
- I. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.5 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect domestic water piping to distribution side of water meter with shutoff valve.
- C. Connect domestic water piping to existing domestic water distribution piping. Use dielectric fitting if connection dissimilar metals. Refer to Application Schedule on the Drawings and Division 20 Section "Basic Mechanical Materials and Methods" for dielectric fittings.
- D. Install piping adjacent to equipment and machines to allow service and maintenance.
- E. Connect domestic water piping to the following:
1. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Refer to Division 22 Section "Plumbing Fixtures."
 2. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.
 3. Booster Pumps: Cold-water suction and discharge piping.
 4. Water Heaters: Cold-water supply and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.

3.6 FIELD QUALITY CONTROL

- A. Domestic water piping as follows:
1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
 2. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

3. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

B. Test domestic water piping as follows:

1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
3. Leave new, altered, extended, or replaced domestic water piping uncovered and uncealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
4. Cap and subject piping to static water pressure of 150 psig. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

3.7 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
 - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide flow of hot water in each branch.
 - b. Adjust calibrated balancing valves to flows indicated.
5. Remove plugs used during testing of piping and plugs used for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.8 CLEANING AND DISINFECTION

A. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

B. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing domestic water piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction or, if methods are not prescribed, procedures described in either AWWA C651 or AWWA C652 or as described below:

- a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
 - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
 - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- C. Prepare and submit reports of purging and disinfecting activities.

END OF SECTION 221116

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."
 - 3. Division 20 Section "Meters and Gages" for thermometers, pressure gages, and flow meters in domestic water piping.
 - 4. Division 22 Section "Domestic Water Piping " for water meters.
 - 5. Division 22 Section "Healthcare Plumbing Fixtures" for thermostatic mixing valves for sitz baths, thermostatic mixing-valve assemblies for hydrotherapy equipment, and outlet boxes for dialysis equipment.
 - 6. Division 22 Section "Emergency Plumbing Fixtures" for water tempering equipment.
 - 7. Division 22 Section "Drinking Fountains, Water Coolers and Cuspidors" for water filters for water coolers.

1.2 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

- A. Shop Drawings: Diagram power, signal, and control wiring.

1.5 CLOSEOUT SUBMITTALS

- A. Field quality-control test reports.
- B. Flow Reports and Settings: For calibrated balancing valves.
- C. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.
- B. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of Lead in Drinking Water Act," about lead content in materials that will be in contact with potable water for human consumption.
- C. NSF Compliance:
 - 1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.
 - 2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."
 - 3. Comply with NSF 372, "Drinking Water System Components - Lead Content" for components with wetted surfaces in contact with potable water.

PART 2 - PRODUCTS

2.1 VACUUM BREAKERS

- A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Apollo Valves; Conbraco Industries, Inc.
 - b. FEBCO; a Division of Watts Water Technologies, Inc.
 - c. Watts Water Technologies, Inc.; Watts Regulator Co.
 - d. Zurn Plumbing Products Group; Wilkins Div.
 2. Standard: ASSE 1001.
 3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
 4. Body: Bronze.
 5. Inlet and Outlet Connections: Threaded.
 6. Finish: Chrome plated.
- B. Hose-Connection Vacuum Breakers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; Conbraco Industries, Inc.
 - b. MIFAB, Inc.
 - c. Watts Water Technologies, Inc.; Watts Regulator Co.
 - d. Woodford Manufacturing Company.
 2. Standard: ASSE 1011.
 3. Body: Bronze or brass, nonremovable, with manual drain.
 4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
 5. Finish: Chrome or nickel plated.
- C. Pressure Vacuum Breakers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; Conbraco Industries, Inc.
 - b. FEBCO; a Division of Watts Water Technologies, Inc.
 - c. Watts Water Technologies, Inc.; Ames Fire & Waterworks.
 - d. Watts Water Technologies, Inc.; Watts Regulator Co.
 - e. Zurn Plumbing Products Group; Wilkins Div.
 2. Standard: ASSE 1020.
 3. Operation: Continuous-pressure applications.
 4. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
 5. Size and Capacity: As indicated on the drawings.
 6. Accessories:
 - a. Valves: Ball type, on inlet and outlet.

2.2 BACKFLOW PREVENTERS

- A. Intermediate Atmospheric-Vent Backflow Preventers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; Conbraco Industries, Inc.
 - b. FEBCO; a Division of Watts Water Technologies, Inc.
 - c. Watts Water Technologies, Inc.; Watts Regulator Co.
 - d. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1012.
3. Operation: Continuous-pressure applications.
4. Size: NPS 1/2.
5. Body: Bronze.
6. End Connections: Union, solder joint.
7. Finish: Chrome plated.

B. Reduced-Pressure-Principle Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; Conbraco Industries, Inc.
 - b. FEBCO; a Division of Watts Water Technologies, Inc.
 - c. Watts Water Technologies, Inc.; Ames Fire & Waterworks.
 - d. Watts Water Technologies, Inc.; Watts Regulator Co.
 - e. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1013.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.
5. Size and Capacities: As scheduled on the drawings.
6. Body: Bronze for NPS 2 and smaller; cast-iron or ductile-iron, with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
7. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
8. Configuration: Designed for horizontal, straight through flow.
9. Accessories:
 - a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.
 - b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.
 - c. Y-Pattern strainer and soft-seated check valve.

C. Double-Check Backflow-Prevention Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; Conbraco Industries, Inc.
 - b. FEBCO; a Division of Watts Water Technologies, Inc.
 - c. Watts Water Technologies, Inc.; Ames Fire & Waterworks.
 - d. Watts Water Technologies, Inc.; Watts Regulator Co.
 - e. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1015.
3. Operation: Continuous-pressure applications, unless otherwise indicated.
4. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
5. Size and Capacities: As scheduled on the drawings.
6. Body: Bronze for NPS 2 and smaller; cast-iron or ductile-iron, with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
7. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
8. Configuration: Designed for horizontal, straight through flow.
9. Accessories:

- a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.

D. Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; Conbraco Industries, Inc.
 - b. Watts Water Technologies, Inc.; Watts Regulator Co.
 - c. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1022.
3. Operation: Continuous-pressure applications.
4. Size: NPS 1/4 or NPS 3/8.
5. Body: Stainless steel or Acetal plastic.
6. End Connections: Threaded.

E. Dual-Check-Valve Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; Conbraco Industries, Inc.
 - b. FEBCO; a Division of Watts Water Technologies, Inc.
 - c. Watts Water Technologies, Inc.; Watts Regulator Co.
 - d. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1024.
3. Operation: Continuous-pressure applications.
4. Size: As indicated on the drawings.
5. Body: Bronze with union inlet.

F. Carbonated-Beverage-Dispenser, Dual-Check-Valve Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Watts Water Technologies, Inc.; Watts Regulator Co.
2. Standard: ASSE 1032.
3. Operation: Continuous-pressure applications.
4. Size: NPS 1/4 or NPS 3/8.
5. Body: Stainless steel.
6. End Connections: Threaded.

G. Hose-Connection Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; Conbraco Industries, Inc.
 - b. Watts Water Technologies, Inc.; Watts Regulator Co.
 - c. Woodford Manufacturing Company.
2. Standard: ASSE 1052.

3. Operation: Up to 10-foot head of water back pressure.
4. Inlet Size: NPS 1/2 or NPS 3/4.
5. Outlet Size: Garden-hose thread complying with ASME B1.20.7.
6. Capacity: At least 3-gpm flow.

2.3 BALANCING VALVES

A. Calibrated Balancing Valves NPS 1/2:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong International, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Apollo Valves; by Conbraco Industries, Inc.
 - d. Bell & Gossett; Xylem Inc.
 - e. Flo Fab Inc.
 - f. Flow Design Inc.
 - g. Griswold Controls.
 - h. NIBCO INC.
 - i. IMI Indoor Climate; Tour & Andersson.
 - j. Taco, Inc.
 - k. Watts Water Technologies, Inc.; Watts Regulator Co.
2. Type: Ball or Y-pattern globe valve with two readout ports and memory setting indicator.
3. Body: Dezincification resistant brass, or bronze.
4. Minimum Flow Rate: 0.3 gpm.
5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

B. Calibrated Balancing Valves NPS 3/4 to NPS 2:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong International, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Apollo Valves; by Conbraco Industries, Inc.
 - d. Bell & Gossett; Xylem Inc.
 - e. Flo Fab Inc.
 - f. Flow Design Inc.
 - g. Griswold Controls.
 - h. NIBCO INC.
 - i. IMI Indoor Climate; Tour & Andersson.
 - j. Taco, Inc.
 - k. Watts Water Technologies, Inc.; Watts Regulator Co.
2. Type: Ball or Y-pattern globe valve with two readout ports and memory setting indicator.
3. Body: Dezincification resistant brass, or bronze.
4. Size: Same as connected piping, but not larger than NPS 2.
5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

C. Calibrated Balancing Valves NPS 2-1/2 to NPS 4:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong International, Inc.
 - b. Bell & Gossett; Xylem Inc.
 - c. Flo Fab Inc.
 - d. Flow Design Inc.
 - e. Griswold Controls.
 - f. NIBCO INC.
 - g. IMI Indoor Climate; Tour & Andersson.
 - h. Watts Water Technologies, Inc.; Watts Regulator Co.
2. Type: Adjustable with Y-pattern globe valve, two readout ports, and memory-setting indicator.
3. Size: Same as connected piping, but not smaller than NPS 2-1/2.
4. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

2.4 TEMPERATURE-ACTUATED WATER MIXING VALVES

A. Water-Temperature Limiting Devices:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acorn Controls; Morris Group International; ST70.
 - b. Apollo Valves; Conbraco Industries, Inc.; Model MVD (34D Series).
 - c. Bradley Corporation.
 - d. Lawler Manufacturing Company, Inc.
 - e. Leonard Valve Company; Series 170-LF and 270-LF.
 - f. Watts Water Technologies, Inc.; Powers Division; Hydroguard Series LFe480, LFG480, and LFLM495.
 - g. Watts Water Technologies, Inc.; Watts Regulator Co.
 - h. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1070.
3. Pressure Rating: 125 psig.
4. Type: Thermostatically controlled water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: 1/2-inch union or 3/8-inch compression; with integral check valves.
7. Accessories: Adjustable temperature-control knob.
8. Outlet Temperature Range: Adjustable from 85 deg F to 120 deg F. Set at 105 deg F.
9. Minimum Flow Rate: 0.5 gpm.
10. Valve Finish: Chrome plated.

B. Primary, Thermostatic, Water Mixing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acorn Controls; Morris Group International; MV17.
 - b. Apollo Valves; Conbraco Industries, Inc.
 - c. Armstrong International, Inc. (RADA).
 - d. Bradley Corporation.
 - e. Lawler Manufacturing Company, Inc.

- f. Leonard Valve Company.
 - g. Symmons Industries, Inc.
 - h. Watts Water Technologies, Inc.; Powers Division.
 - i. Watts Water Technologies, Inc.; Watts Regulator Co.
 - j. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1017.
 3. Type: Cabinet-type, thermostatically controlled water mixing valve.
 4. Material: Bronze body with corrosion-resistant interior components.
 5. Connections: Threaded union inlets and outlet.
 6. Accessories: Manual temperature control, check stops and strainers on hot- and cold-water supplies, and adjustable, temperature-control handle.
 7. Valve Pressure Rating: 125 psig minimum, unless otherwise indicated.
 8. Size, Settings, and Capacities: As scheduled on the drawings.
 9. Valve Finish: Chrome plated.
 10. Cabinet: Factory-fabricated, stainless steel, for surface mounting and with hinged, stainless-steel door.

C. Manifold, Thermostatic, Water-Mixing-Valve Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; Conbraco Industries, Inc.; Model MVHL (34HL Series).
 - b. Leonard Valve Company.
 - c. Symmons Industries, Inc.
 - d. Watts Water Technologies, Inc.; Powers Division.
2. Description: Factory-fabricated, cabinet-type, thermostatically controlled, water-mixing-valve assembly in two-valve parallel arrangement.
3. Large-Flow Parallel: Thermostatic water mixing valve and downstream pressure regulator with pressure gages on inlet and outlet.
4. Intermediate-Flow Parallel: Thermostatic water mixing valve and downstream pressure regulator with pressure gages on inlet and outlet.
5. Small-Flow Parallel: Thermostatic water mixing valve.
6. Thermostatic Mixing Valves: Comply with ASSE 1017. Include check stops and strainers on hot- and cold-water inlets and shutoff valve on outlet.
7. Water Regulator(s): Comply with ASSE 1003. Include pressure gage on inlet and outlet.
8. Component Pressure Ratings: 125 psig minimum, unless otherwise indicated.
9. Cabinet: Factory-fabricated, stainless steel, for surface mounting and with hinged, stainless-steel door.
10. Size, Settings, and Capacities: As scheduled on the drawings.
11. Thermostatic Mixing Valve and Water Regulator Finish: Chrome plated.

D. Automatic Temperature Control Mixing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acorn Controls; Morris Group International; ST7069.
 - b. Apollo Valves; Conbraco Industries, Inc.; 34 HL Series.
 - c. Lawler Manufacturing Company, Inc.
2. Standard: ASSE 1069.
3. Type: Cabinet-type, thermostatically controlled water mixing valve.
4. Material: Bronze body with corrosion-resistant interior components.
5. Connections: Threaded inlets and outlet.

6. Accessories: Manual temperature control, check stops and strainers on hot- and cold-water supplies, and adjustable, temperature-control.
7. Valve Pressure Rating: 125 psig minimum, unless otherwise indicated.
8. Tempered-Water Setting: Maximum 120 deg F.
9. Size and Capacities: As scheduled on the drawings.
10. Valve Finish: Chrome plated.
11. Cabinet: Factory-fabricated, stainless steel, for surface mounting and with hinged, stainless-steel door.

2.5 PREPIPED TEMPERED WATER MIXING SYSTEM

A. General

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acorn Controls; Morris Group International.
 - b. Armstrong International, Inc. (RADA).
 - c. Bradley Corporation.
 - d. Lawler Manufacturing Company, Inc.; Pre-piped 802 Hi-Low Tempered water Mixing System.
 - e. Leonard Valve Company.
 - f. Symmons Industries, Inc.
 - g. Watts Water Technologies, Inc.; Powers Division.
 - h. Watts Water Technologies, Inc.; Watts Regulator Co.
2. Description: Completely assembled and tested pre-piped manifold system including mixing valve(s), recirculation pump, circuit setting balancing valve, aquastat, circulator switch box, thermometers, isolation valves, mounting strut, and test connection.
3. Standard: ASSE 1017.
4. Mixing Valve: Exposed-mounting, thermostatically controlled water mixing valve.
 - a. Material: Bronze body with corrosion-resistant interior components.
 - b. Connections: Threaded union inlets and outlet.
 - c. Accessories: Manual temperature control, check stops and strainers on hot- and cold-water supplies, and adjustable, temperature-control handle.
 - d. Valve Pressure Rating: 125 psig minimum, unless otherwise indicated.
 - e. Size, Settings, and Capacities: As scheduled on the drawings.
 - f. Valve Finish: Rough bronze.
5. Pump: Meeting requirements in Division 22 Section "Domestic Water Circulation Pumps."
6. Mounting Strut: Meeting requirements in Division 20 Section "Hangers and Supports."

2.6 DIGITAL MIXING AND RECIRCULATION SYSTEM

A. Digitally Controlled Thermostatic, Water Mixing and Recirculation Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Watts Water Technologies, Inc.; Powers Division; IntelliStation.

- b. Lawler Manufacturing Company, Inc.; Series 800 SEA Valve Deluxe Recirculation System.
 - c. Armstrong International, Inc.; The Brain.
 - d. AERCO; a Watts Brand; ADMS.
 2. Description: Digital temperature controller designed to deliver blended water economically at safe, accurate temperature for use in re-circulated hot water systems.
 - a. High/Low Thermostatic Mixing Valve: Liquid-filled thermal motor; stainless steel piston and liner; union end stop; check valve inlets with stainless steel strainers; vandal-resistant temperature adjustment. Incorporated into pre-piped manifolded system which includes recirculating pump, thermostatic balancing valve, isolation valves and mounting strut.
 3. System shall digitally monitor and display the following without the use of an external module, laptop and special software that must be downloaded:
 - a. Hot and cold water inlet supply pressure in deg F.
 - b. Hot and cold water inlet supply temperature in deg F.
 - c. Mixed outlet temperature and mixed outlet set point in deg F.
 - d. Return temperature and pressure in psig.
 - e. Energy units displayed in therms (TH), gigajoules (GJ), kilowatts (kWh) and British thermal units (MBTU).
 - f. Highest mixed outlet temperature recorded (since last reset).
 - g. Lowest mixed outlet temperature recorded (since last reset).
 - h. Recirculation pump run time in hours.
 - i. Energy consumed (since last reset).
 - j. Highest hot water inlet supply temperature (since last reset).
 - k. Lowest hot water inlet supply temperature (since last reset).
 - l. Highest measured load flow (since last reset).
 4. Control module shall integrate with building automation systems through Bacnet and Modbus protocols without use of separate module, and feature local and remote temperature alarms. System shall also feature password protected, user-selected high-temperature sanitization mode for operation as part of user's safe and properly designed thermal bacteria eradication protocol.
 5. Standards: ASSE 1017 and CSA B125.3.
 6. Type: Exposed-mounting.
 7. Connections: Threaded inlets and outlet.
 8. Maximum Operating Pressure: 125 psig.
 9. Maximum Hot Water Temperature: 200 deg F.
 10. Recirculation Pump: As specified in Division 22 Section "Domestic Water Circulation Pumps."
 11. Isolation Valves: As specified in Division 22 Section "General Duty Valves for Plumbing."
 12. Capacities and Settings: As scheduled on the drawings.
 13. Valve Finish: Rough bronze Chrome plated.

2.7 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Manufacturers:
 - a. Apollo Valves; Conbraco Industries, Inc.

- b. Keckley Company.
 - c. Metraflex Company.
 - d. Mueller Steam Specialty; a Watts Brand.
 - e. NIBCO, Inc.
 - f. Titan Flow Control, Inc.
 - g. Watts.
 - h. Yarway; Emerson Automation Solutions.
2. CWP: 200 psig minimum, unless otherwise indicated.
3. SWP: 125 psig minimum, unless otherwise indicated.
4. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and for NPS 2-1/2 and larger.
5. End Connections: Threaded or soldered for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
6. Screen: Stainless steel with round perforations, unless otherwise indicated.
7. Perforation Size:
 - a. Strainers NPS 2 and Smaller: 0.033 inch
 - b. Strainers NPS 2-1/2 to NPS 4: 0.045 inch.
 - c. Strainers NPS 5 and Larger: 0.045 inch .
8. Drain: Pipe plug.

2.8 OUTLET BOXES

A. Clothes Washer Outlet Boxes:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Sioux Chief Manufacturing Company, Inc.; Ox Box.
 - b. Oatey SCS.
 - c. Guy Gray Manufacturing Co., Inc.
2. Mounting: Recessed.
3. Material and Finish: Enameled- or epoxy-painted-steel or Stainless-steel box and faceplate.
4. Faucet: Combination, valved fitting or separate hot- and cold-water, valved fittings complying with ASME A112.18.1. Include garden-hose thread complying with ASME B1.20.7 on outlets.
5. Supply Shutoff Fittings: NPS 1/2 gate, globe, or ball valves and NPS 1/2 copper, water tubing.
6. Drain: NPS 2 standpipe and P-trap for direct waste connection to drainage piping.
7. Inlet Hoses: Two 60-inch- long, rubber household clothes washer inlet hoses with female, garden-hose-thread couplings. Include rubber washers.
8. Drain Hose: One 48-inch- long, rubber household clothes washer drain hose with hooked end.

B. Icemaker Outlet Boxes:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Sioux Chief Manufacturing Company, Inc.; Ox Box.
 - b. Oatey SCS.

- c. LSP Products Group, Inc.
 - d. Acorn Engineering Company.
2. Mounting: Recessed.
 3. Material and Finish: Enameled- or epoxy-painted-steel or Stainless-steel box and faceplate.
 4. Faucet: Valved fitting complying with ASME A112.18.1. Include NPS 1/2 or smaller copper tube outlet.
 5. Supply Shutoff Fitting: NPS 1/2 gate, globe, or ball valve and NPS 1/2 copper, water tubing.

2.9 FIRE-RATED OUTLET BOXES

A. Fire-Rated Clothes Washer Outlet Boxes:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Sioux Chief Manufacturing Company, Inc.; Ox Box.
 - b. Oatey SCS; Fire-Rated Washing Machine Outlet Boxes.
2. Certification: Warnock Hersey certified for 1-hour and 2-hour fire-rated walls.
3. Mounting: Recessed. Using galvanized steel bracket.
4. Material and Finish: Bulk molded compound thermoset fire-rated plastic.
5. Faucets: Separate hot- and cold-water, 1/4-turn valved fittings complying with ASME A112.18.1. Include garden-hose thread complying with ASME B1.20.7 on outlets.
6. Water Hammer Arrestors: Integral.
7. Drain: NPS 2 PVC tailpiece.
8. Drain Piece Metal Sleeve: Galvanized steel with integrated intumescent pad.
9. Box Pad: UL Classified Unifrax FyreWrap insulation material.

B. Fire-Rated Ice Maker Outlet Boxes:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Sioux Chief Manufacturing Company, Inc.; Ox Box.
 - b. Oatey SCS; Fire-Rated Ice Maker Outlet Boxes.
2. Certification: Warnock Hersey certified for 1-hour and 2-hour fire-rated walls.
3. Mounting: Recessed. Using galvanized steel bracket.
4. Material and Finish: Bulk molded compound thermoset fire-rated plastic.
5. Faucet: Cold-water, 1/4-turn valved fittings.
6. Water Hammer Arrestors: Integral.
7. Box Pad: UL Classified Unifrax FyreWrap insulation material.

2.10 HOSE BIBBS

A. Hose Bibbs:

1. Standard: ASME A112.18.1 for sediment faucets.
2. Body Material: Bronze.
3. Seat: Bronze, replaceable.
4. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.

6. Pressure Rating: 125 psig.
7. Vacuum Breaker: Integral nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
8. Finish for Equipment Rooms: Chrome or nickel plated.
9. Finish for Service Areas: Chrome or nickel plated.
10. Finish for Finished Rooms: Chrome or nickel plated.
11. Operation for Equipment Rooms: Wheel handle or operating key.
12. Operation for Service Areas: Operating key.
13. Operation for Finished Rooms: Operating key.
14. Include operating key with each operating-key hose bibb.
15. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.11 WALL HYDRANTS

A. Nonfreeze Wall Hydrants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Water Technologies, Inc.; Watts Regulator co.
 - f. Woodford Manufacturing Company.
 - g. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.21.3M for self-draining wall hydrants.
3. Pressure Rating: 125 psig.
4. Operation: Loose key.
5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
6. Inlet: NPS 3/4 or NPS 1.
7. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
8. Box: Deep, flush mounting with cover.
9. Box and Cover Finish: Polished nickel bronze or chrome plated.
10. Outlet: Exposed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
11. Nozzle and Wall-Plate Finish: Polished nickel bronze.
12. Operating Keys(s): Two with each wall hydrant.

B. Vacuum Breaker Wall Hydrants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Smith, Jay. R. Mfg. Co.; Division of Smith Industries, Inc.
 - b. Watts Water Technologies, Inc.; Watts Regulator Co.
 - c. Woodford Manufacturing Company.
 - d. Zurn Plumbing Products Group; Light Commercial Operation.
2. Standard: ASSE 1019, Type A or Type B.
3. Type: Freeze-resistant, automatic draining with integral air-inlet valve.
4. Classification: Type B, for automatic draining with hose removed or with hose attached and nozzle closed.
5. Pressure Rating: 125 psig.

6. Operation: Loose key.
7. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
8. Inlet: NPS 1/2 or NPS 3/4.
9. Outlet: Exposed with garden-hose thread complying with ASME B1.20.7.

2.12 WATER HAMMER ARRESTERS

A. Water Hammer Arresters (Copper Tube Type):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. MIFAB, Inc.
 - b. PPP Inc.
 - c. Sioux Chief Manufacturing Company, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - e. Tyler Pipe; Wade Div.
 - f. Watts Drainage Products Inc.
 - g. Watts Water Technologies, Inc.; Watts Regulator Co.
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

B. Water Hammer Arresters (Metal Bellows Type):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMTROL, Inc.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - e. Tyler Pipe; Wade Div.
 - f. Watts Drainage Products Inc.
 - g. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Precharged stainless steel bellows.
4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

2.13 AIR VENTS

A. Bolted-Construction Automatic Air Vents:

1. Body: Bronze.
2. Pressure Rating: 125-psig minimum pressure rating at 140 deg F.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 3/8 minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

B. Welded-Construction Automatic Air Vents:

1. Body: Stainless steel.
2. Pressure Rating: 150-psig minimum pressure rating.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 3/8 minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

2.14 TRAP-SEAL PRIMER VALVES

A. Drainage-Type, Trap-Seal Primer Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. PPP Inc.; Tail Piece Trap Priming Assembly.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
2. Standard: ASSE 1044, lavatory P-trap with NPS 1/2 minimum, trap makeup connection.
3. Size: NPS 1-1/4 minimum.
4. Material: Chrome-plated, cast brass.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for piping joining materials, joint construction, and basic installation requirements.
- B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
 1. Locate backflow preventers in same room as connected equipment or system.
 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
 3. Do not install bypass piping around backflow preventers.
 4. Install strainer and soft-seated check valve upstream of backflow preventer. Exception: Fire protection backflow preventers.
- C. Install water regulators with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.
- D. Install water control valves with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.
- E. Install balancing valves in locations where they can easily be adjusted.
- F. Install temperature-actuated water mixing valves with strainers, and check stops or shutoff valves on inlets and with shutoff valve on outlet.

1. Install thermometers and water regulators if specified.
 2. Install cabinet-type units recessed in or surface mounted on wall as specified.
- G. Install outlet boxes recessed in wall. Install 2-by-4-inch fire-retardant-treated-wood blocking wall reinforcement between studs. Fire-retardant-treated-wood blocking is specified in Division 06 Section "Rough Carpentry."
- H. Install non-freeze, nondraining-type post hydrants set in concrete or pavement.
- I. Install water hammer arresters in water piping according to PDI-WH 201.
- J. Install air vents at high points of water piping.
- K. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.
- L. Install drainage-type, trap-seal primer valves as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.
- M. Install trap-seal primer systems with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 20 and 22 Sections. Drawings indicate general arrangement of piping and specialties.

3.3 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
1. Pressure vacuum breakers.
 2. Intermediate atmospheric-vent backflow preventers.
 3. Reduced-pressure-principle backflow preventers.
 4. Double-check backflow-prevention assemblies.
 5. Carbonated-beverage-machine backflow preventers.
 6. Dual-check-valve backflow preventers.
 7. Water pressure-reducing valves.
 8. Calibrated balancing valves.
 9. Primary, thermostatic, water mixing valves.
 10. Manifold, thermostatic, water-mixing-valve assemblies.
 11. Photographic-process, thermostatic, water-mixing-valve assemblies.
 12. Primary water tempering valves.
 13. Outlet boxes.
 14. Hose stations.
 15. Supply-type, trap-seal primer valves.
 16. Trap-seal primer systems.
- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 20 Section "Mechanical Identification."

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and prepare test reports:
 - 1. Test each backflow prevention device according to authorities having jurisdiction and the device's reference standard.
- B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.5 ADJUSTING

- A. Set field-adjustable pressure set points of water pressure-reducing valves.
- B. Set field-adjustable flow set points of balancing valves as follows:
 - 1. Set calibrated balancing valves at calculated presettings.
 - 2. Measure flow each station and adjust where necessary.
 - 3. Record settings and mark balancing devices.
- C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION 221119

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."
 - 3. Division 22 Section "Domestic Water Packaged Booster Pumps" for booster systems.
 - 4. Division 20 Section "Pipe Flexible Connectors, Expansion Fittings and Loops."

1.2 DEFINITIONS

- A. PEI: Pump Energy Index as defined by the Department of Energy.
- B. PEI_{CL}: Pump Energy Index - Constant Load, as defined by the Department of Energy.
- C. PEI_{VL}: Pump Energy Index - Variable Load, as defined by the Department of Energy.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type and size of domestic water pump specified. Include certified performance curves with operating points plotted on curves; and rated capacities of selected models, furnished specialties, and accessories.

1.4 INFORMATIONAL SUBMITTALS

- A. Shop Drawings: Diagram power, signal, and control wiring.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For domestic water pumps to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of domestic water pumps and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.
- C. Department of Energy Requirements: Pumps supplied that are regulated by the Department of Energy pump standards shall bear the acceptable PEI index.
 - 1. Constant load pumps supplied shall bear the acceptable PEI_{CL} index.
 - 2. Variable load pumps supplied with variable speed controls shall bear the acceptable PEI_{VL} index.
 - 3. Submittals for approval shall clearly identify the applicable PEI index and affirm that that index meets the DOE pump standards.
- D. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of Lead in Drinking Water Act," about lead content in materials that will be in contact with potable water for human consumption.
- E. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," and NSF 372 Drinking Water System Components - Lead Content for potable domestic water piping and components.
- F. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Retain shipping flange protective covers and protective coatings during storage.
- B. Protect bearings and couplings against damage.
- C. Comply with pump manufacturer's written rigging instructions for handling.

1.8 COORDINATION

- A. Coordinate size and location of concrete bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 CLOSE-COUPLED, IN-LINE CENTRIFUGAL PUMPS (SMALL)

- A. Manufacturers:
1. Armstrong Pumps Inc.
 2. Bell & Gossett; Xylem Inc.; Series PL.
 3. Grundfos Pumps Corp.
 4. Taco, Inc.; Series 1400.
- B. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, close-coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3; and designed for installation with pump and motor shafts mounted horizontally.
1. Pump Construction: All bronze.
 - a. Casing: Radially split, bronze, with threaded companion-flange connections.
 - b. Impeller: Glass-reinforced corrosion-resistant material; keyed to shaft.
 - c. Shaft: High-strength alloy steel.
 - d. Seal: Mechanical, carbon/silicon carbide seal.
 - e. Bearings: Permanently oil-lubricated type.
 2. Motor-Single speed, with oil-lubricated bearings, unless otherwise indicated; and directly mounted to pump casing. Comply with requirements in Division 20 Section "Motors."
- C. Capacities and Characteristics: Refer to Schedule on Drawings.

2.3 CONTROLS

- A. Thermostats: Electric; adjustable for control of hot-water circulation pump.
1. Manufacturers:
 - a. Honeywell International, Inc.; Aquastat.
 - b. Johnson Controls, Inc.
 - c. Schneider Electric USA, Inc.
 - d. Siemens Industry, Inc.; Building Technologies Division.
 - e. White-Rodgers Div.; Emerson Electric Co.
 2. Type: Strap-on sensor, with suitable removable spring clip attaching thermostat to hot-water circulation piping.
 3. Range: 65 to 200 deg F .
 4. Operation of Pump: On or off.

5. Transformer: Provide if required.
6. Power Requirement: 24 V, ac or 120 V, ac.
7. Settings: Start pump at 110 deg F and stop pump at 120 deg F.

2.4 FLEXIBLE CONNECTORS

- A. Refer to Division 20 Section "Pipe Flexible Connectors, Expansion Fittings and Loops."

2.5 BUILDING-AUTOMATION-SYSTEM INTERFACE

- A. Provide auxiliary contacts in pump controllers for interface to building automation system. Include the following:
 1. On-off status of each pump.
 2. Alarm status.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in of domestic-water-piping system to verify actual locations of connections before pump installation.

3.2 PUMP INSTALLATION

- A. Comply with HI 1.4.
- B. Install pumps with access for periodic maintenance including removal of motors, impellers, couplings, and accessories.
- C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping. Do not use pump motors as a support point.
- D. Install centrifugal pumps with motor and pump shafts horizontal.
- E. Install continuous-thread hanger rods and of sufficient size to support pump weight. Vibration isolation devices are specified in Division 20 Section "Mechanical Vibration Controls." Fabricate brackets or supports as required. Hanger and support materials are specified in Division 20 Section "Hangers and Supports."

3.3 CONTROL INSTALLATION

- A. Install thermostats in hot-water return piping.
- B. Install timers where indicated on Drawings.

3.4 CONNECTIONS

- A. Piping installation requirements are specified in other Division 20 and 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to pumps to allow service and maintenance.
- C. Connect domestic water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles. Refer to Division 22 Section "Domestic Water Piping."
 - 1. Install flexible connectors adjacent to pumps in suction and discharge piping of the following pumps:
 - a. Separately coupled, in-line centrifugal pumps.
 - b. Separately coupled, horizontally mounted, in-line centrifugal pumps.
 - c. Close-coupled, horizontally mounted, in-line centrifugal pumps.
 - d. Close-coupled, vertically mounted, in-line centrifugal pumps.
 - 2. Install shutoff valve and strainer on suction side of pumps, and check valve and throttling valve on discharge side of pumps. Install valves same size as connected piping. Refer to Division 20 Section "Valves" for general-duty valves for domestic water piping and Division 22 Section "Domestic Water Piping Specialties" for strainers.
 - 3. Install pressure gages at suction and discharge of pumps. Install at integral pressure-gage tapings where provided or install pressure-gage connectors in suction and discharge piping around pumps. Refer to Division 20 Section "Meters and Gages" for pressure gages and gage connectors.
- D. Ground equipment according to Division 26 Section "Grounding and Bonding."
- E. Connect wiring according to Division 26 Section "Conductors and Cables."
- F. Connect to pumps that they control.
- G. Interlock pump with water heater burner and time delay relay.

END OF SECTION 221123

SECTION 221316 - SANITARY WASTE AND VENT PIPING

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements".
 - 2. Division 20 Section "Basic Mechanical Materials and Methods".
 - 3. Division 22 Section "Drainage Piping Specialties".
 - 4. Division 22 Section "Chemical-Waste Piping" for chemical-waste and vent piping systems.
 - 5. Division 22 Section "Sewage Pumps."
 - 6. Division 22 Section "Sanitary Waste and Vent Piping" for piping outside building.

1.2 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. EPDM: Ethylene-propylene-diene terpolymer rubber.

- C. LLDPE: Linear, low-density polyethylene plastic.
- D. NBR: Acrylonitrile-butadiene rubber.
- E. PE: Polyethylene plastic.
- F. PVC: Polyvinyl chloride plastic.
- G. TPE: Thermoplastic elastomer.

1.3 SYSTEMS DESCRIPTIONS

- A. Sanitary waste and vent piping system materials are scheduled on the Drawing.

1.4 ACTION SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings.

1.5 CLOSEOUT SUBMITTALS

- A. Field quality-control inspection and test reports.

1.6 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Cast-iron soil pipe shall be marked with the collective trademark of Cast Iron Soil Pipe Institute (CISPI).
- C. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; "NSF-drain" for plastic drain piping; "NSF-tubular" for plastic continuous waste piping; and "NSF-sewer" for plastic sewer piping.

1.7 PROJECT CONDITIONS

- A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
 - 1. Notify Construction Manager no fewer than two days in advance of proposed interruption of sanitary waste service.
 - 2. Do not proceed with interruption of sanitary waste service without Construction Manager's written permission.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. Heavy-Duty, Hubless-Piping Couplings:
1. Manufacturers:
 - a. ANACO-Husky; McWane Plumbing Group; SD 4000.
 - b. Ferguson Enterprises, Inc.; ProFlo (Private labeled IDEAL-TRIDON).
 - c. IDEAL-TRIDON; Heavy-Duty "HD" No-Hub Couplings.
 - d. Norma Group; Clamp-All Products; HI-TORQ 125.
 2. Standards: ASTM C 1277 and ASTM C 1540, or ASTM C 1277 and FM 1680 Class I.
 3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.3 COPPER TUBE AND FITTINGS

- A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.
1. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.
- B. Hard Copper Tube: ASTM B 88, Types M, water tube, drawn temper.
1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
 2. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
 3. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
- C. Hard Copper Tube: ASTM B 88, Types L, water tube, drawn temper.
1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
 2. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
 3. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

2.4 PVC PIPE AND FITTINGS

- A. Solid-Wall PVC Pipe: Schedule 40, ASTM D 2665, drain, waste, and vent.
 - 1. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

2.5 SPECIALTY PIPE FITTINGS

- A. Flexible, Nonpressure Pipe Couplings: Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition pattern. Include shear ring, ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - 1. Manufacturers:
 - a. Dallas Specialty & Mfg. Co.
 - b. Fernco, Inc.
 - c. Logan Clay Products Company (The).
 - d. Mission Rubber Co.
 - e. NDS, Inc.
 - f. Plastic Oddities, Inc.
 - 2. Sleeve Materials:
 - a. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
 - b. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
 - c. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
- B. Shielded Nonpressure Pipe Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - 1. Manufacturers:
 - a. Cascade Waterworks Mfg. Co.
 - b. Mission Rubber Co.
- C. Rigid, Unshielded, Nonpressure Pipe Couplings: ASTM C 1461, sleeve-type reducing- or transition-type mechanical coupling molded from ASTM C 1440, TPE material with corrosion-resistant-metal tension band and tightening mechanism on each end.
 - 1. Manufacturers:
 - a. ANACO.
- D. Pressure Pipe Couplings: AWWA C219 metal, sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.
 - 1. Manufacturers:
 - a. Cascade Waterworks Mfg. Co.
 - b. Dresser, Inc.; DMD Div.
 - c. Ford Meter Box Company, Inc. (The); Pipe Products Div.
 - d. JCM Industries, Inc.

- e. Smith-Blair, Inc.
- f. Viking Johnson.

- 2. Center-Sleeve Material: Manufacturer's standard.
- 3. Gasket Material: Natural or synthetic rubber.
- 4. Metal Component Finish: Corrosion-resistant coating or material.

- E. Wall-Penetration Fittings: Compound, ductile-iron coupling fitting with sleeve and flexing sections for up to 20-degree deflection, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.
 - 1. Manufacturers:
 - a. SIGMA Corp.

PART 3 - EXECUTION

3.1 EXCAVATION

- A. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING SYSTEM INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Sanitary sewer piping outside the building is specified in Division 22 Section "Sanitary Sewerage."
- C. Basic piping installation requirements are specified in Division 20 Section "Basic Mechanical Materials and Methods."
- D. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.
- E. Install cleanout fitting with closure plug inside the building in sanitary force-main piping.
- F. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 20 Section "Basic Mechanical Materials and Methods."
- G. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
- H. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from

horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

- I. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- J. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
 - 1. Building Sanitary Drain: 1/8-inch per foot downward in direction of flow, unless otherwise noted.
 - 2. Horizontal Sanitary Drainage Piping: 1/8-inch per foot downward in direction of flow, unless otherwise noted.
 - 3. Vent Piping: 1/8-inch per foot down toward vertical fixture vent or toward vent stack.
- K. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
- L. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.
- M. Install underground PVC soil and waste drainage piping according to ASTM D 2321.
- N. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.3 JOINT CONSTRUCTION

- A. Basic piping joint construction requirements are specified in Division 20 Section "Basic Mechanical Materials and Methods."
- B. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- C. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.
- D. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.
- E. Join stainless-steel pipe and fittings with gaskets according to ASME A112.3.1.
- F. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

3.4 SPECIALTY PIPE FITTING INSTALLATION

- A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in OD's.
2. In Drainage Piping: Unshielded, nonpressure transition couplings.

3.5 VALVE INSTALLATION

- A. General valve installation requirements are specified in Division 20 Section "Valves."
- B. Shutoff Valves: Install shutoff valve on each sewage pump discharge.
 1. Install gate or full-port ball valve for piping NPS 2 and smaller.
 2. Install gate valve or butterfly valve for piping NPS 2-1/2 and larger.
- C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.
 1. Horizontal Piping: Horizontal backwater valves. Use normally closed type, unless otherwise indicated.
 2. Floor Drains: Drain outlet backwater valves, unless drain has integral backwater valve.
 3. Install backwater valves in accessible locations.
 4. Backwater valves are specified in Division 22 Section "Drainage Piping Specialties."

3.6 HANGER AND SUPPORT INSTALLATION

- A. Pipe hangers and supports are specified in Division 20 Section "Hangers and Supports." Install the following:
 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
 2. Install individual, straight, horizontal piping runs according to the following:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.
 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Install supports according to Division 20 Section "Hangers and Supports."
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.
- E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
 1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
 2. NPS 3: 60 inches with 1/2-inch rod.
 3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
 4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
 5. NPS 10 and NPS 12: 60 inches with 7/8-inch rod.

- F. Install supports for vertical cast-iron soil piping every 15 feet.
- G. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/4: 84 inches with 3/8-inch rod.
 - 2. NPS 1-1/2: 108 inches with 3/8-inch rod.
 - 3. NPS 2: 10 feet with 3/8-inch rod.
 - 4. NPS 2-1/2: 11 feet with 1/2-inch rod.
 - 5. NPS 3: 12 feet with 1/2-inch rod.
 - 6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
 - 7. NPS 6 and NPS 8: 12 feet with 3/4-inch rod.
 - 8. NPS 10 and NPS 12: 12 feet with 7/8-inch rod.
- H. Install supports for vertical steel piping every 15 feet.
- I. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/4: 72 inches with 3/8-inch rod.
 - 2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
 - 3. NPS 2-1/2: 108 inches with 1/2-inch rod.
 - 4. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
 - 5. NPS 6: 10 feet with 5/8-inch rod.
 - 6. NPS 8: 10 feet with 3/4-inch rod.
- J. Install supports for vertical copper tubing every 10 feet.
- K. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect drainage and vent piping to the following:
 - 1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
 - 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
 - 3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
 - 4. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.
- D. Connect force-main piping to the following:
 - 1. Sanitary Sewer: To exterior force main or sanitary manhole.
 - 2. Sewage Pumps: To sewage pump discharge.

3.8 IDENTIFICATION

- A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Division 20 Section "Mechanical Identification."

3.9 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - 2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
 - 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
 - 5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 - 6. Prepare reports for tests and required corrective action.

3.10 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.

- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION 221316

SECTION 221319 - DRAINAGE PIPING SPECIALTIES

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."
 - 3. Division 22 Section "Plumbing Fixtures" for hair interceptors.
 - 4. Division 22 Section "Healthcare Plumbing Fixtures" for plaster sink interceptors.

1.2 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. FRP: Fiberglass-reinforced plastic.
- C. HDPE: High-density polyethylene plastic.
- D. PE: Polyethylene plastic.

- E. PP: Polypropylene plastic.
- F. PVC: Polyvinyl chloride plastic.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For drainage piping specialties to include in operation and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

1.6 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate size and location of roof penetrations.

PART 2 - PRODUCTS

2.1 CAST-IRON CLEANOUTS

- A. Size: Cleanouts shall be same nominal size as the pipe they serve up to 4 inches. For pipes larger than 4 inches nominal size, minimum size of cleanout shall be 4 inches.
- B. Exposed Cast-Iron Cleanouts:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.; Series 58910.
 - b. MIFAB, Inc.; C1460.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.; 4510 Series.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
 - 2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
 - 3. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch or hubless, cast-iron soil pipe test tee as required to match connected piping.
 - 4. Closure: Countersunk or raised-head, brass or bronze plug with tapered threads.

C. Cast-Iron Floor Cleanouts (On-Grade Interior Floor Areas):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.; C1220-R.
 - c. Sioux Chief Manufacturing Company, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.; Model 4023S-F.
 - e. Tyler Pipe; Wade Div.
 - f. Watts Drainage Products Inc.
 - g. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M.
3. Type: Adjustable housing.
4. Body or Ferrule: Cast iron.
5. Clamping Device: Not required.
6. Outlet Connection: Spigot.
7. Closure: Brass, bronze, or plastic plug with tapered threads.
8. Adjustable Housing Material: Cast iron with threads, set-screws or other device.
9. Frame and Cover Material and Finish: Nickel-bronze, copper alloy with scoriated cover in service areas, and recessed cover to accept floor finish material in finished floor areas.
10. Frame and Cover Shape: Round.
11. Top Loading Classification: Medium Duty.
12. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

D. Cast-Iron Floor Cleanouts (Not-On-Grade Interior Floor Areas):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.; C-1100-C-R-34.
 - c. Sioux Chief Manufacturing Company, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.; Model 4333C.
 - e. Tyler Pipe; Wade Div.
 - f. Watts Drainage Products Inc.
 - g. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M.
3. Type: Adjustable housing.
4. Body or Ferrule: Cast iron.
5. Clamping Device: Required.
6. Outlet Connection: Spigot.
7. Closure: Brass, bronze, or plastic plug with tapered threads.
8. Adjustable Housing Material: Cast iron with threads, set-screws or other device.
9. Frame and Cover Material and Finish: Nickel-bronze, copper alloy with scoriated cover in service areas, and recessed cover to accept floor finish material in finished floor areas.
10. Frame and Cover Shape: Round.
11. Top Loading Classification: Medium Duty.
12. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

E. Cast-Iron Wall Cleanouts (Finished Wall Areas):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.; Model 58790-20.
 - b. MIFAB, Inc.; C1460-RD.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M. Include wall access.
3. Body: Hub-and-spigot, cast-iron soil pipe T-branch or hubless, cast-iron soil pipe test tee as required to match connected piping.
4. Closure: Countersunk or raised-head, drilled-and-threaded bronze or brass plug with tapered threads.
5. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.
6. Wall Access: Round, nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.

2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains (Toilet Rooms, Labs, and Janitor's Closet) FD-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Sioux Chief Manufacturing Company, Inc.; Finish Line Adjustable Drainage System.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.; Model 2005Y-A.
 - e. Tyler Pipe; Wade Div.
 - f. Watts Drainage Products Inc.
 - g. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.6.7.
3. Pattern: Floor drain.
4. Body Material: Gray iron.
5. Seepage Flange: Required.
6. Clamping Device: Required.
7. Outlet: Bottom unless otherwise noted.
8. Coating on Interior and Exposed Exterior Surfaces: Enamel.
9. Top or Strainer Material: Nickel bronze.
10. Top of Body and Strainer Finish: Nickel bronze.
11. Top Shape: Round, with vandal proof screws.
12. Dimensions of Top or Strainer: 7 inch diameter.
13. Top Loading Classification: Light Duty.
14. Inlet Fitting: Gray iron, with spigot outlet.

B. Cast-Iron Floor Drains (Mechanical Rooms, Electrical Rooms, and Penthouses) FD-3:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.

- c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.; Model 2142.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.6.7.
 3. Pattern: Floor drain.
 4. Body Material: Gray iron.
 5. Seepage Flange: Required.
 6. Clamping Device: Required.
 7. Outlet: Bottom unless otherwise noted.
 8. Coating on Interior and Exposed Exterior Surfaces: Enamel.
 9. Sediment Bucket: 3-3/4 inches deep, slotted sediment bucket with lift bar.
 10. Top or Strainer Material: Cast-iron.
 11. Top Shape: Round.
 12. Dimensions of Top or Strainer: 11-1/2 inch diameter tractor grate, 29 square inches of free area.
 13. Top Loading Classification: Heavy Duty.
 14. Outlet Fitting: Gray iron, with spigot outlet.

2.3 FLOOR SINKS

A. Stainless-Steel Floor Sink Drains FS-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.; Model 3006-12.
 - d. Tyler Pipe; Wade Div.
 - e. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.6.7.
3. Outlet: Bottom unless otherwise noted.
4. Top or Strainer Material: Stainless steel.
5. Top Shape: Square.
6. Dimensions of Top or Strainer: 12 inch by 12 inch, 14 gage, Type 304 stainless steel ribbed, non-tilt loose set half grate with 1/2 inch square holes and perforated stainless steel sediment bucket.
7. Seepage Flange: Required.
8. Clamping Device: Required.

B. Stainless-Steel Floor Sink Drains FS-2:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.; Model 3007-NB-13.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.6.7.

3. Outlet: Bottom unless otherwise noted.
4. Top or Strainer Material: Stainless steel.
5. Top Shape: Square.
6. Dimensions of Top or Strainer: 12 inch by 12 inch, 14 gage, Type 304 stainless steel ribbed, non-tilt loose set 3/4-grate with 1/2 inch square holes and domed bottom strainer.
7. Seepage Flange: Required.
8. Anchor Flange: 6 inch deep body.
9. Clamping Device: Required.

C. Cast-Iron Floor Sink Drains FS-3:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.; Model 2632.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.6.7.
3. Pattern: Floor drain.
4. Body Material: Gray iron.
5. Seepage Flange: Required.
6. Clamping Device: Required.
7. Outlet: Bottom.
8. Coating on Interior and Exposed Exterior Surfaces: Enamel.
9. Top or Strainer Material: Gray iron.
10. Top of Body and Strainer Finish: Gray iron.
11. Top Shape: Square.
12. Dimensions of Top or Strainer: 10 inch by 10 inch, having 28 square inches of free area, and with flat bottom strainer.
13. Top Loading Classification: Light Duty.
14. Outlet Connection: Gray iron, with spigot outlet.

D. Cast-Iron Floor Sink Drains FS-4:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation; Z1960-4.
2. Standard: ASME A112.6.7.
3. Pattern: Floor drain.
4. Body Material: Gray iron.
5. Seepage Flange: Required.
6. Clamping Device: Required.
7. Outlet: Bottom.
8. Coating on Interior and Exposed Exterior Surfaces: Acid resistant enamel.
9. Top Material: Gray iron.

10. Strainer: ABS anti-splash interior bottom dome strainer.
11. Top Shape: Round.
12. Grate: Full light-duty grate with square center opening.
13. Dimensions: 8 inch diameter by 6 inches deep.
14. Outlet Connection: Gray iron, with spigot outlet.

2.4 CHANNEL DRAINAGE SYSTEMS LD-1

A. Stainless-Steel Channel Drainage Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Blucher Drainage Systems; a Watts Water Technologies Company.
 - b. Eric'sons, Inc.; Dura Trench.
 - c. MultiDrain Systems.
 - d. Zurn Plumbing Products Group; Flo-Thru Operation.
2. Type: Modular system of stainless-steel channel sections, grates, and appurtenances; designed so grates fit into channel recesses without rocking or rattling.
 - a. Channel Sections: Interlocking-joint, stainless steel with level invert.
 - 1) Dimensions: 6 inches wide. Include number of units required to form total lengths indicated.
 - b. Grates: Manufacturer's designation "medium duty," with slots or perforations, and of width and thickness that fit recesses in channels.
 - 1) Material: Stainless steel.
 - 2) Locking Mechanism: Manufacturer's standard device for securing grates to channel sections.
 - c. Covers: Solid stainless steel, of width and thickness that fit recesses in channels, and of lengths indicated.
 - d. Supports, Anchors, and Setting Devices: Manufacturer's standard, unless otherwise indicated.
 - e. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.

2.5 AUTOMATIC DRAIN TEMPERING VALVE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Therm-Omega-Tech, Inc.; DTV Drain Tempering Valve.
- B. Body Material: Brass.
- C. Internal Components: 300 Series stainless steel.
- D. Seat Seal: PTFE.
- E. Thermal Actuator: Spring operated and clog-resistant.

- F. Maximum Inlet Pressure Limits: 125 psig maximum working pressure.
- G. Maximum Temperature: 250 deg F maximum working temperature.

2.6 ROOF FLASHING ASSEMBLIES

- A. Roof Flashing Assemblies:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acorn Engineering Company; Elmdor/Stoneman Div.
 - b. Thaler Metal Industries Ltd.
 - B. Description: Manufactured assembly consisting of metal flashing collar and skirt extending at least 6 inches from pipe, with boot reinforcement and counterflashing fitting.
 - 1. Open-Top Vent Cap: Without cap.
 - 2. Low-Silhouette Vent Cap: With vandal-proof vent cap.
 - 3. Extended Vent Cap: With field-installed, vandal-proof vent cap.

2.7 ROOF DRAINS

- A. Metal Combination Primary/Secondary Roof Drains, RD-1:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Froet Industries LLC; 100C Series.
 - b. Watts Drainage Products Inc.; RD-700.
 - 2. Standard: ASME A112.6.4 and IAPMO IGC 187-2003.
 - 3. Pattern: Bi-functional roof drain and overflow drain.
 - 4. Body Material: Cast iron.
 - 5. Outlets:
 - a. Bottom overflow outlet.
 - b. Side or angle primary outlet.
 - 6. Dome Material: Cast iron or ductile iron.
 - 7. Overflow Strainer: Debris strainer for overflow pipe
 - 8. Sump Receiver: Required.
 - 9. Extension Collars: Required.
 - 10. Underdeck Clamp: Required.
 - 11. Roof Drain Options:
 - a. Low Profile Roof Drain: 4-inch overflow height
 - b. Finishing Ring: Recessed ring to allow the drain body to be installed in flush configuration, or to be used to install drain with extensions used to adjust for thicker deck sections.
 - c. IRMA Guard: 4-inch high Type 304 stainless steel perforated gravel guard (attaches to drain ring to prevent ballast and debris from entering drain area when installed with an IRMA roofing system).

- d. Deck Mounting Plate: Allows drain to be direct mounted to plate and eliminates need for deck clamp.

B. Scupper Roof Drains RD-4:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.6.4.
3. Pattern: Scupper drain.
4. Body Material: Cast iron.
5. Grate: Angle style secured grate with vandal proof screws. Nickel bronze with rectangular holes.
6. Outlet: 45 degree, threaded, unless otherwise noted.
7. Flashing Clamp: Required.

2.8 MISCELLANEOUS DRAINAGE PIPING SPECIALTIES

A. Hub Outlets:

1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron, soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C 564, rubber gaskets.
2. Size: Same as connected waste piping.

B. Air-Gap Fittings:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

C. Stack Flashing Fittings:

1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

D. Vent Caps:

1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
2. Size: Same as connected stack vent or vent stack.

E. Downspout Boots:

1. Description: Manufactured, ASTM A 48/A 48M, gray-iron casting, with strap or ears for attaching to building; NPS 4 outlet; and shop-applied bituminous coating.
2. Size: Inlet size to match downspout.
3. Description: ASTM A 74, Service class, hub-and-spigot, cast-iron soil pipe.
4. Size: Same as or larger than connected downspout.

F. Conductor Nozzles DNZ-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.; Model 1770-NB-BS.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.; RD-940-83.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Description: Bronze body with threaded inlet, bronze wall flange with mounting holes, and bird screen.
3. Size: Same as connected conductor.

G. Downspout Covers DC-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.; Fig. No. 1775.
 - b. Zurn Plumbing Products Group; Specification Drainage Operation; Z199-DC.
2. Description: Round fabricated stainless steel frame with mounting holes, and with fabricated secured perforated stainless steel hinged strainer.
3. Size: Same as connected conductor.

2.9 FLASHING MATERIALS

- A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:
 1. General Use: 4.0-lb/sq. ft., 0.0625-inch thickness.
 2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.
 3. Burning: 6-lb/sq. ft., 0.0938-inch thickness.
- B. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness, unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.
- C. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.
- D. Fasteners: Metal compatible with material and substrate being fastened.

- E. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- F. Solder: ASTM B 32, lead-free alloy.
- G. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

2.10 GREASE INTERCEPTORS

A. Grease Interceptors:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. Lowe Engineering; a div. of Highland Tank & Manufacturing Co., Inc.
 - c. MIFAB, Inc.
 - d. Schier Products Company.
 - e. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - f. Tyler Pipe; Wade Div.
 - g. Watts Drainage Products Inc.
 - h. Zurn Plumbing Products Group.
- 2. Standard: ASME A112.14.3, for intercepting and retaining fats, oils, and greases from food-preparation or -processing wastewater.
- 3. Plumbing and Drainage Institute Seal: Required.
- 4. Body Material: Cast iron, steel, or polypropylene.
- 5. Interior Lining: Corrosion-resistant enamel for cast iron or steel bodies. Not required for polypropylene bodies.
- 6. Exterior Coating: Corrosion-resistant enamel for cast iron or steel bodies. Not required for polypropylene bodies.
- 7. Body Extension: Not required.
- 8. Size and Capacities: As indicated on the drawings.
- 9. Cleanout: Integra.
- 10. Mounting: Above floor.
- 11. Flow-Control Fitting: Required.
- 12. Operation: Manual cleaning.

2.11 SOLIDS INTERCEPTORS

A. General

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Striem.
 - e. Tyler Pipe; Wade Div.
 - f. Watts Drainage Products Inc.
 - g. Zurn Plumbing Products Group; Specification Drainage Operation.
- 2. Type: Factory-fabricated interceptor made for removing and retaining sediment from wastewater.

3. Body Material: Cast iron, steel, or polypropylene.
4. Interior Separation Device: Baffles.
5. Interior Lining: Corrosion-resistant enamel for cast iron or steel bodies. Not required for polypropylene bodies.
6. Exterior Coating: Corrosion-resistant enamel for cast iron or steel bodies. Not required for polypropylene bodies.
7. Size and Capacities: As indicated on the drawings.
8. Mounting: Above floor.

PART 3 - EXECUTION

3.1 CONCRETE BASES

A. Anchor interceptors to concrete bases.

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 19-inch centers around full perimeter of base.
2. For installed equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be imbedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.
5. Concrete base construction requirements are specified in Division 20 Section "Basic Mechanical Materials and Methods."
6. Cast-in-place concrete materials and placement requirements are specified in Division 03.

3.2 INSTALLATION

A. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for piping joining materials, joint construction, and basic installation requirements.

B. Install backwater valves in building drain piping. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.

1. Installation of Access Hand Holes:

- a. Install boxes level and plumb and with orientation and depth coordinated with connecting piping to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of piping, and seal joint between box and extension as recommended by the manufacturer.
- b. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

C. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.

3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
 4. Locate at base of each vertical soil and waste stack.
- D. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- E. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- F. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
1. Position floor drains for easy access and maintenance.
 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
 - a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
 - b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
 - c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
 3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
 4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- G. Assemble stainless-steel channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.
- H. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.
- I. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.
- J. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions. Roofing materials are specified in Division 07.
1. Install roof-drain flashing collar or flange so that there will be no leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
 2. Position roof drains for easy access and maintenance.
- K. Assemble open drain fittings and install with top of hub 2 inches above floor.
- L. Install deep-seal traps on floor drains and other waste outlets, if indicated.
- M. Install floor-drain, trap-seal primer fittings on floor drains that require trap-seal primer connection.
- N. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

- O. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- P. Install vent caps on each vent pipe passing through roof.
- Q. Install conductor nozzles at exposed bottom of conductors where they spill onto grade.
- R. Install grease interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing.
 - 1. Above-Floor Installation: Set unit with bottom resting on floor, unless otherwise indicated.
- S. Install solids interceptors with cleanout immediately downstream from interceptors that do not have integral cleanout on outlet. Install trap on interceptors that do not have integral trap and are connected to sanitary drainage and vent systems.
- T. Install wood-blocking reinforcement for wall-mounting-type specialties.
- U. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.
- V. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.
- W. Install through-penetration firestop assemblies for penetrations of fire- and smoke-rated assemblies.
 - 1. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 20 and 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Grease Interceptors: Connect inlet and outlet to unit, and connect flow-control fitting and vent to unit inlet piping. Install valve on outlet of automatic drawoff-type unit.

3.4 FLASHING INSTALLATION

- A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
 - 1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
 - 2. Copper Sheets: Solder joints of copper sheets.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.
- E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 07 Section "Sheet Metal Flashing and Trim."
- F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.
- G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.5 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
1. Solids interceptors.
 2. Grease interceptors.
- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 20 Section "Mechanical Identification."

3.6 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319

SECTION 221413 - STORM DRAINAGE PIPING

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."
 - 3. Division 22 Section "Drainage Piping Specialties."
 - 4. Division 22 Section "Sump Pumps."
 - 5. Division 33 Section "Storm Utility Drainage Piping" for piping outside building.

1.2 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. LLDPE: Linear, low-density polyethylene plastic.
- C. PE: Polyethylene plastic.
- D. PVC: Polyvinyl chloride plastic.
- E. TPE: Thermoplastic elastomer.

1.3 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working-pressure, unless otherwise indicated:
 - 1. Storm Drainage Piping: 10-foot head of water.

1.4 SYSTEMS DESCRIPTIONS

- A. Storm drainage piping system materials are scheduled on the Drawing.

1.5 ACTION SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings.

1.6 INFORMATIONAL SUBMITTALS

- A. Shop Drawings:

1.7 CLOSEOUT SUBMITTALS

- A. Field quality-control inspection and test reports.

1.8 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Cast-iron soil pipe shall be marked with the collective trademark of Cast Iron Soil Pipe Institute (CISPI).
- C. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; "NSF-drain" for plastic drain piping and "NSF-sewer" for plastic sewer piping.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. Heavy-Duty, Hubless-Piping Couplings:

1. Manufacturers:

- a. ANACO-Husky; McWane Plumbing Group; SD 4000.
- b. Ferguson Enterprises, Inc.; ProFlo (Private labeled IDEAL-TRIDON).
- c. IDEAL-TRIDON; Heavy-Duty "HD" No-Hub Couplings.
- d. Norma Group; Clamp-All Products; HI-TORQ 125.

- 2. Standards: ASTM C 1277 and ASTM C 1540, or ASTM C 1277 and FM 1680 Class I.
- 3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.3 SPECIAL PIPE FITTINGS

A. Flexible, Nonpressure Pipe Couplings: Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition pattern. Include shear ring, ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Manufacturers:

- a. Dallas Specialty & Mfg. Co.
- b. Fernco, Inc.
- c. Logan Clay Products Company (The).
- d. Mission Rubber Co.
- e. NDS, Inc.
- f. Plastic Oddities, Inc.

2. Sleeve Materials:

- a. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
- b. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
- c. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

B. Shielded Nonpressure Pipe Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Manufacturers:

- a. Cascade Waterworks Mfg. Co.
- b. Mission Rubber Co.

C. Pressure Pipe Couplings: AWWA C219 metal, sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.

1. Manufacturers:

- a. Cascade Waterworks Mfg. Co.
- b. Dresser, Inc.; DMD Div.
- c. EBAA Iron Sales, Inc.
- d. Ford Meter Box Company, Inc. (The); Pipe Products Div.
- e. JCM Industries, Inc.
- f. Romac Industries, Inc.

- g. Smith-Blair, Inc.
 - h. Viking Johnson.
 - 2. Center-Sleeve Material: Manufacturer's standard.
 - 3. Gasket Material: Natural or synthetic rubber.
 - 4. Metal Component Finish: Corrosion-resistant coating or material.
- D. Wall-Penetration Fittings: Compound, ductile-iron coupling fitting with sleeve and flexing sections for up to 20-degree deflection, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.
 - 1. Manufacturers:
 - a. SIGMA Corp.

PART 3 - EXECUTION

3.1 EXCAVATION

- A. Refer to Division 31 Section "Earthwork" for excavating, trenching, and backfilling.

3.2 PIPING SYSTEM INSTALLATION

- A. Storm sewer and drainage piping outside the building are specified in Division 33 Section "Storm Drainage."
- B. Basic piping installation requirements are specified in Division 20 Section "Basic Mechanical Materials and Methods."
- C. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers. Cleanouts are specified in Division 22 Section "Drainage Piping Specialties."
- D. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping.
- E. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 20 Section "Basic Mechanical Materials and Methods."
- F. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
- G. Make changes in direction for storm piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- H. Lay buried building drain piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written

instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

- I. Install storm drainage piping at the following minimum slopes, unless otherwise indicated:
 - 1. Building Storm Drain: 1/8-inch per foot downward in direction of flow, unless otherwise noted.
 - 2. Horizontal Storm-Drainage Piping: 1/8-inch per foot downward in direction of flow, unless otherwise noted.
- J. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
- K. Install underground PVC storm drainage piping according to ASTM D 2321.
- L. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.3 JOINT CONSTRUCTION

- A. Basic piping joint construction requirements are specified in Division 20 Section "Basic Mechanical Materials and Methods."
- B. Hubless Cast-Iron Soil Piping Coupled Joints: Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.
- C. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

3.4 VALVE INSTALLATION

- A. General valve installation requirements are specified in Division 20 Section "Valves."

3.5 HANGER AND SUPPORT INSTALLATION

- A. Pipe hangers and supports are specified in Division 20 Section "Hangers and Supports." Install the following:
 - 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs: According to the following:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.
 - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Install supports according to Division 20 Section "Hangers and Supports."
- C. Support vertical piping and tubing at base and at each floor.

- D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.
- E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
 - 2. NPS 3: 60 inches with 1/2-inch rod.
 - 3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
 - 4. NPS 6: 60 inches with 3/4-inch rod.
 - 5. NPS 8 to NPS 12: 60 inches with 7/8-inch rod.
 - 6. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.
- F. Install supports for vertical cast-iron soil piping every 15 feet.
- G. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/4: 84 inches with 3/8-inch rod.
 - 2. NPS 1-1/2: 108 inches with 3/8-inch rod.
 - 3. NPS 2: 10 feet with 3/8-inch rod.
 - 4. NPS 2-1/2: 11 feet with 1/2-inch rod.
 - 5. NPS 3: 12 feet with 1/2-inch rod.
 - 6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
 - 7. NPS 6: 12 feet with 3/4-inch rod.
 - 8. NPS 8 to NPS 12: 12 feet with 7/8-inch rod.
- H. Install supports for vertical steel piping every 15 feet.
- I. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.6 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect storm drainage piping to roof drains and storm drainage specialties.

3.7 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
 - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - 2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 3. Test Procedure: Test storm drainage piping on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
 - 4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 - 5. Prepare reports for tests and required corrective action.

3.8 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION 221413

SECTION 221429 - SUMP PUMPS

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."
 - 3. Division 22 Section "Sewage Pumps" for applications in sanitary drainage systems.

1.2 SUMMARY

- A. This Section includes sump pumps and accessories, inside the building, for building storm drainage systems.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type and size of sump pump specified, include certified performance curves with operating points plotted on curves, rated capacities of selected models, furnished specialties, and accessories.

1.4 INFORMATIONAL SUBMITTALS

- A. Shop Drawings: Diagram power, signal, and control wiring.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each sump pump to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of sump pumps and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Retain shipping flange protective covers and protective coatings during storage.
- B. Protect bearings and couplings against damage.
- C. Comply with pump manufacturer's written rigging instructions for handling.

1.8 COORDINATION

- A. Coordinate size and location of concrete basins and pits. Concrete, reinforcement, and formwork requirements are specified in Division 03.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 WET-PIT-MOUNTED, VERTICAL SUMP PUMPS

- A. Manufacturers:
 - 1. Armstrong Pumps Inc.
 - 2. Aurora Pump; Pentair Pump Group (The).
 - 3. Crane Pumps & Systems; Deming Pumps.

4. Crane Pumps & Systems; Weinman.
 5. Sterling Peerless; Sterling Fluid Systems Group.
 6. Vertiflo Pump Company.
 7. Weil Pump Company, Inc.
- B. Description: Factory-assembled and -tested, single-stage, centrifugal, end-suction sump pumps complying with UL 778. Vertical, separately coupled, suspended pumps complying with Hydraulic Institute HI 1.1-1.2 and HI 1.3 for wet-pit-volute sump pumps.
1. Pump Arrangement: Duplex.
 2. Casing: Cast iron, with screened inlet and threaded connection for NPS 2 and smaller and flanged connection for NPS 2-1/2 and larger discharge piping.
 3. Impeller: abrasion-resistant cast iron statically and dynamically balanced non-clog design; overhung, single suction, keyed and secured to shaft.
 4. Pump Shaft and Sleeve Bearings: Stainless-steel shaft with bronze sleeve bearings. Include oil-lubricated, intermediate sleeve bearings at 48-inch maximum intervals if basin depth is more than 48 inches, and grease-lubricated, ball-type thrust bearings.
 5. Pump and Motor Shaft Coupling: Flexible, capable of absorbing torsional vibration and shaft misalignment.
- C. Pump Discharge Piping: Refer to Division 22 Section "Storm Drainage Piping."
- D. Basin Cover: Cast iron or steel with bituminous coating and strong enough to support pumps, motors, and controls. See Part 2 "Sump Pump Basins" Article for requirements.
- E. Cover Shaft Seal: Stuffing box, with graphite-impregnated braided-yarn rings and bronze packing gland.
- F. Motor: Single speed; grease-lubricated ball bearings. Comply with requirements in Division 20 Section "Motors" with built-in thermal-overload protection appropriate for motor size and duty.
1. Mounting: On vertical, cast-iron pedestal.
- G. Controls:
1. Mount controls in NEMA 250, Type 4X enclosure. Controls shall include: Fused disconnect switches and combination magnetic starters with overload protection for each phase to protect against single phasing. Three phase units shall include control transformer and control circuit fuse.
 - a. Minimum SCCR according to UL 508 shall be as indicated on the Drawings, whichever is greater.
 2. Furnish an automatic alternator with manual on-off switch to change sequence of pump operation on the completion of each pump cycle.
 - a. Each motor shall have branch power circuit and controls with one of the following disconnecting means having SCCR to match main disconnecting means:
 - 1) NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 60947-4-1.
 - 2) NEMA KS 1, heavy-duty, nonfusible switch.

- 3) UL 489, motor-circuit protector (circuit breaker) with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.]
3. Mount three position, hand-off-auto, selector switches and magnetic starter manual reset push-buttons on the control panel door for manual operation and resetting of the magnetic starters.
4. Station shall be furnished with three, single pole, normally-open NON-mercury mechanical float switches with 20 ft. cords, clamps, cord grips, and fasteners for pump off/pump on/high-water-alarm operation. The high-water-alarm switch shall be mounted as indicated on the Drawings. System shall be complete with cover mounting bracket. (1-inch diameter support pole by Contractor.)
5. Station shall be furnished with four, single pole, normally-open NON-mercury mechanical float switches with 20 ft. cords, clamps, cord grips, and fasteners for pump off/lead pump on/lag pump on/high-water-alarm operation. The high-water-alarm switch shall be mounted as indicated on the Drawings. System shall be complete with cover mounting bracket. (1-inch diameter support pole by Contractor.)
6. Provide B/W Series 7014 Uni-float level sensing system with the following components:
 - a. One magnetic float fabricated from Type 316 stainless steel.
 - b. Guide tube fabricated from Type 316 stainless steel, with float stop at the bottom. Guide tube length should be approximately 12 inches less than the sump depth.
 - c. Pressure tight weather-proof holder, fabricated from Type 316 stainless steel, to support the guide tube from the top of the tank.
 - d. Stilling well fabricated from Type 316 stainless steel and extending 3 inches past the end of the guide tube.
 - e. Type I magnetically latching reed switches suspended at operating level control points as defined on the drawings. Reed switches are to have two leads with isolated contact, calibrated for use with water. Reed switch contacts to operate on level rise shall be normally open.
7. Provide high water alarm switch, complete with actuating mechanism for operation on an electric circuit other than the motor circuit. The switch shall be designed to operate indicated alarm device(s) and one set of spare contacts whenever a predetermined high-water level is reached in the sump. Provide alarm pilot light and alarm bell with silence switch. Mount controls on pedestal on the sump cover plate.

2.3 SUBMERSIBLE SUMP PUMPS

A. Manufacturers:

1. ABS Pumps, Inc.
2. Bell & Gossett; Xylem Inc.
3. Crane Pumps and Systems; Barnes.
4. EBARA International Corporation; Standard Pump Division.
5. Goulds Pumps; Xylem Inc.
6. Gorman-Rupp Company (The).
7. Grundfos Pumps Corporation.
8. Hydromatic.
9. Little Giant Pump Co.
10. Metropolitan Industries, Inc.
11. Weil Pump Company, Inc.
12. Zoeller Company.

- B. Description: Factory-assembled and -tested, quick-disconnect, duplex single-stage, centrifugal, end-suction, submersible, direct-connected sump pumps complying with UL 778 and Hydraulic Institute HI 1.1-1.2 and HI 1.3 for submersible sump pumps.
- C. Casing: Cast iron; with cast-iron inlet strainer, legs that elevate pump to permit flow into impeller, and vertical discharge with companion flange for piping connection.
- D. Casing: Stainless steel; with stainless-steel inlet strainer, legs that elevate pump to permit flow into impeller, and vertical discharge with companion flange suitable for piping connection.
- E. Impeller: ASTM A 532/A 532M, abrasion-resistant cast iron; statically and dynamically balanced, semi-open non-clog design, overhung, single suction, keyed and secured to shaft.
- F. Pump and Motor Shaft: Stainless steel, with factory-sealed, grease-lubricated ball bearings and double-mechanical seals.
- G. Motor: Hermetically sealed, capacitor-start type, with built-in overload protection; three-conductor waterproof power cable of length required, and with grounding plug and cable-sealing assembly for connection at pump. Comply with requirements in Division 20 Section "Motors."
 - 1. Moisture-Sensing Probe: Internal moisture sensor with moisture alarm.
- H. Pump Discharge Piping: Factory or field fabricated. Refer to Division 22 Section "Storm Drainage Piping."
- I. Basin Cover: Cast iron or steel with bituminous coating and strong enough to support controls. See Part 2 "Sump Pump Basins Pits" Article for other requirements.
- J. Controls:
 - 1. Mount controls in NEMA 250, Type 4X enclosure. Controls shall include: Fused disconnect switches and combination magnetic starters with overload protection for each phase to protect against single phasing. Three phase units shall include control transformer and control circuit fuse.
 - a. Minimum SCCR according to UL 508 shall be as indicated on the Drawings, whichever is greater.
 - 2. Furnish an automatic alternator with manual on-off switch to change sequence of pump operation on the completion of each pump cycle.
 - a. Each motor shall have branch power circuit and controls with one of the following disconnecting means having SCCR to match main disconnecting means:
 - 1) NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 60947-4-1.
 - 2) NEMA KS 1, heavy-duty, nonfusible switch.
 - 3) UL 489, motor-circuit protector (circuit breaker) with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.]

3. Mount three position, hand-off-auto, selector switches and magnetic starter manual reset push-buttons on the control panel door for manual operation and resetting of the magnetic starters.
4. Station shall be furnished with four, single pole, normally-open NON-mercury mechanical float switches with 20 ft. cords, clamps, cord grips, and fasteners for pump off/lead pump on/lag pump on/high-water-alarm operation. The high-water-alarm switch shall be mounted as indicated on the Drawings. System shall be complete with cover mounting bracket. (1-inch diameter support pole by Contractor.)
5. Provide B/W Series 7014 Uni-float level sensing system with the following components:
 - a. One magnetic float fabricated from Type 316 stainless steel.
 - b. Guide tube fabricated from Type 316 stainless steel, with float stop at the bottom. Guide tube length should be approximately 12 inches less than the sump depth.
 - c. Pressure tight weather-proof holder, fabricated from Type 316 stainless steel, to support the guide tube from the top of the tank.
 - d. Stilling well fabricated from Type 316 stainless steel and extending 3 inches past the end of the guide tube.
6. Provide high water alarm switch, complete with actuating mechanism for operation on an electric circuit other than the motor circuit. The switch shall be designed to operate indicated alarm device(s) and one set of spare contacts whenever a predetermined high-water level is reached in the sump. Provide alarm pilot light and alarm bell with silence switch. Mount controls on pedestal on the sump cover plate.

K. Guide-Rail Supports: Include the following for each sump pump:

1. Guide Rails: Vertical pipes or structural members, made of galvanized steel or other corrosion-resistant metal, attached to baseplate and basin sidewall or cover.
2. Baseplate: Corrosion-resistant metal plate, attached to basin floor, supporting guide rails and stationary elbow.
3. Pump Yoke: Motor-mounted or casing-mounted yokes or other attachments for aligning pump during connection of flanges.
4. Movable Elbow: Pump discharge-elbow fitting with flange, seal, and positioning device.
5. Stationary Elbow: Fixed discharge-elbow fitting with flange that mates to movable-elbow flange and support attached to baseplate.
6. Lifting Cable: Stainless Steel; attached to pump and cover at manhole.

2.4 SUMP PUMP BASINS

- A. Manufacturer: Sump pump and basin are to be provided by the same manufacturer.
- B. Description: Factory fabricated basin with sump, pipe connections, and separate cover.
- C. Sump: Fabricate watertight, with sidewall openings for pipe connections.
 1. Material: Fiberglass.
 2. Reinforcement: Mounting plates for pumps, fittings, and accessories.
 3. Anchor Flange: Same material as or compatible with sump, cast in or attached to sump, in location and of size required to anchor basin in concrete slab.

- D. Cover: Fabricate with openings having gaskets, seals, and bushings, for access to pumps, pump shafts, control rods, discharge piping, vent connections, and power cables.
 - 1. Material: Cast iron or steel.
 - 2. Reinforcement: Steel or cast iron, capable of supporting foot traffic for basins installed in foot-traffic areas.
- E. Capacity and Characteristics:
 - 1. Refer to Drawings for capacity and characteristics.

2.5 BUILDING AUTOMATION SYSTEM INTERFACE

- A. Provide auxiliary contacts in pump controllers for interface to building automation system. Include the following:
 - 1. On-off status of each pump.
 - 2. Alarm status.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in of plumbing piping to verify actual locations of storm drainage piping connections before sump pump installation.

3.2 CONCRETE

- A. Install concrete bases of dimensions indicated for pumps and controllers. Refer to Division 20 Section "Basic Mechanical Materials and Methods."
- B. Cast-in-place concrete materials and placement requirements are specified in Division 03.

3.3 SUMP PUMP INSTALLATION

- A. Excavating, trenching, and backfilling are specified in Division 31 Section "Earthwork."
- B. Install sump pumps according to applicable requirements in Hydraulic Institute HI 1.4.
- C. Install pumps and arrange to provide access for maintenance including removal of motors, impellers, couplings, and accessories.
- D. Suspend wet-pit-mounted, vertical sump pumps from basin and pit covers. Make direct connections to storm drainage piping.
- E. Set submersible sump pumps on basin or pit floor. Make direct connections to storm drainage piping.

- F. Install self-priming trash pumps as indicated on the drawings. Make direct connections to storm drainage piping.
- G. Install sump pump basins and connect to drainage piping. Brace interior of basins according to manufacturer's written instructions to prevent distortion or collapse during concrete placement. Set basin cover and fasten to basin top flange. Install cover so top surface is flush with finished floor.
- H. Construct sump pump pits and connect to drainage piping. Set pit curb frame recessed in and anchored to concrete. Fasten pit cover to pit curb flange. Install cover so top surface is flush with finished floor.
- I. Install packaged, submersible, drainage pump unit basins on floor or concrete base unless recessed installation is indicated. Make direct connections to storm drainage piping.
- J. Support piping so weight of piping is not supported by pumps.

3.4 CONNECTIONS

- A. Piping installation requirements are specified in Division 22 Section "Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to sump pumps to allow service and maintenance.
- C. Connect storm drainage piping to pumps. Install discharge piping equal to pump discharge connection size. If pump discharge connection size is different from storm drainage piping size, provide transition from pump discharge piping size to storm drainage piping size. Refer to Division 22 Section "Storm Drainage Piping."
 - 1. Install check and shutoff valves on discharge piping from each pump. Install unions on pumps having threaded pipe connections. Install valves same size as connected piping. Refer to Division 20 Section "Valves" for general-duty valves for drainage piping.
- D. Ground equipment according to Division 26 Section "Grounding and Bonding."
- E. Connect wiring according to Division 26 Section "Conductors and Cables."

3.5 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Verify bearing lubrication.
 - 3. Disconnect couplings and check motors for proper direction of rotation.
 - 4. Verify that each pump is free to rotate by hand. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
- B. Start pumps without exceeding safe motor power:
 - 1. Start motors.
 - 2. Open discharge valves slowly.
 - 3. Check general mechanical operation of pumps and motors.

- C. Test and adjust controls and safeties.
- D. Remove and replace damaged and malfunctioning components.
 - 1. Pump Controls: Set pump controls for automatic start, stop, and alarm operation as required for system application.
 - 2. Set field-adjustable switches and circuit-breaker trip ranges as indicated, or if not indicated, for normal operation.
- E. 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 outside normal occupancy hours for this purpose.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain controls and pumps. Refer to Division 20 Section "Mechanical General Requirements."

END OF SECTION 221429

SECTION 223410 - CONDENSING, FUEL-FIRED DOMESTIC WATER HEATERS

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Section includes the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."
 - 3. Division 23 Section "Breechings, Chimneys, and Stacks."

1.2 ACTION SUBMITTALS

- A. Product Data: For each type and size of water heater indicated. Include rated capacities, operating characteristics, furnished specialties, and accessories.

1.3 INFORMATIONAL SUBMITTALS

- A. Shop Drawings: Detail water heater assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection
 - 1. Wiring Diagrams: Power, signal, and control systems. Differentiate between manufacturer-installed and field-installed wiring.
- B. Product Certificates: For each type of water heater, signed by product manufacturer.
- C. Source quality-control test reports.

1.4 CLOSEOUT SUBMITTALS

- A. Field quality-control test reports.
- B. Operation and Maintenance Data: For water heaters to include in operation and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain same type of water heaters through one source from a single manufacturer.
- B. Product Options: Drawings indicate size, profiles, and dimensional requirements of water heaters and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a NRTL acceptable to authorities having jurisdiction, and marked for intended use.
- D. ASME Compliance:
 - 1. Where ASME-code construction is indicated, fabricate and label commercial water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
 - 2. Where ASME-code construction is indicated, fabricate and label commercial, finned-tube water heaters to comply with ASME Boiler and Pressure Vessel Code: Section IV.
 - 3. Where ASME-code construction is indicated, fabricate and label commercial direct-fired storage water heaters to comply with ASME Boiler and Pressure Vessel Code: Section IV, HLW.
- E. ASHRAE Standards: Comply with performance efficiencies prescribed for the following:
 - 1. ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings," for commercial water heaters.
- F. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 and NSF 372.

1.6 COORDINATION

- A. Coordinate size and location of concrete bases with Architectural and Structural Drawings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 COMMERCIAL, GAS WATER HEATERS

A. Commercial, Modulating/Condensing, High-Efficiency, Tank-Type Gas Water Heaters: Comply with ANSI Z21.10.3/CSA 4.3.

1. Manufacturer's proprietary design to provide minimum thermal efficiency of 95 percent at optimum operating conditions.
2. Manufacturers:
 - a. Bock Water Heaters, Inc.; OptiTherm Series
 - b. Bradford White Corporation; EF Series.
 - c. Heat Transfer Products, Inc. (HTP); Phoenix Series.
 - d. Laars Heating Systems; a Subsidiary of Bradford White Corporation; U.H.E. Series.
 - e. Lochinvar Corporation; Shield and TurboCharger Series.
 - f. Rheem Water Heating; Triton Series.
 - g. Smith, A. O. Water Products Company; Cyclone Xi Series.
3. Storage-Tank Construction: ASME-code steel or Type 316L stainless steel with 150-psig minimum working-pressure rating.
 - a. Tappings: Factory fabricated of materials compatible with tank. Attach tappings to tank before testing.
 - 1) NPS 2 and Smaller: Threaded ends according to ASME B1.20.1.
 - 2) NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges, and according to ASME B16.24 for copper and copper-alloy flanges.
 - b. Lining for Steel Tanks: Glass complying with NSF 61 barrier materials for potable-water tank linings, including extending lining into and through tank fittings and outlets.
4. Factory-Installed, Storage-Tank Appurtenances:
 - a. Anode Rod or Impressed Current Cathodic Protection: Required for glass-lined tanks.
 - b. Dip Tube: Provide unless cold-water inlet is near bottom of tank.
 - c. Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
 - d. Insulation: Comply with ASHRAE/IESNA 90.1.
 - e. Jacket: Plastic, or steel with enameled finish.
 - f. Combination Temperature and Pressure Relief Valves: ANSI Z21.22/CSA 4.4. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating.
5. Burner and Heat Exchanger:
 - a. Pre-mix power burner and submerged combustion chamber.
 - b. Helical or spiral heat exchanger coil.
 - c. Comply with ANSI Z21.10.3, UL 795 or approved NRTL requirements for high-efficiency water heaters and for natural-gas fuel.

6. Sealed Combustion/Direct Vent: Combustion air is ducted to the combustion chamber from the outdoors.
7. Temperature Control: Digital display for system monitoring and temperature adjustment.
8. Safety Controls: Automatic, high-temperature-limit and low-water cutoff devices or systems.
9. Energy Management System Interface: Normally closed dry contacts for enabling and disabling water heater.
10. Capacity and Characteristics: Refer to Schedule on Drawings.

2.3 EXPANSION TANKS

- A. Description: Steel, pressure-rated tank, ASME-code constructed with welded joints and factory-installed, butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
1. Manufacturers:
 - a. AMTROL Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett; Xylem Inc.
 - d. Taco, Inc.
 - e. Wessels Co.
 2. Construction:
 - a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
 - b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
 - c. Air-Charging Valve: Factory installed.
 3. Capacity and Characteristics: Refer to Schedule on Drawings.

2.4 WATER HEATER ACCESSORIES

- A. Gas Shutoff Valves: ANSI Z21.15/CGA 9.1, manually operated. Furnish for installation in piping.
- B. Gas Pressure Regulators: ANSI Z21.18, appliance type. Include pressure rating, capacity, and pressure differential required between gas supply and water heater.
- C. Gas Automatic Valves: ANSI Z21.21, appliance, electrically operated, on-off automatic valve.
- D. Combination Temperature and Pressure Relief Valves: Include relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select each relief valve with sensing element that extends into storage tank.
1. Gas Water Heaters: ANSI Z21.22/CSA 4.4.
- E. Pressure Relief Valves: Include pressure setting less than working-pressure rating of water heater.

1. Gas Water Heaters: ANSI Z21.22/CSA 4.4.

F. Flue Side Condensate Neutralizer:

1. Description: Designed to raise the PH level of flue side condensate to near neutral prior to condensate entering the sanitary drainage system.
2. Materials: Neutralizer constructed of PVC pipe and fittings mounted on channel strut base with galvanized or stainless steel clamps and hardware; and charged with calcium carbonate.
3. Manufacturers:
 - a. Axiom Industries Ltd.; NeutraPal and NeutraPro Series.
 - b. BKI Industries, Inc.; Acid Neutralizer Kits.
 - c. J.J.M. Boiler Works; JM Neutralizing Tubes.
 - d. Neutrasafe Corporation; Neutra-Safe Condensate Neutralizers.
 - e. Any of the approved water heater manufacturers.

2.5 SOURCE QUALITY CONTROL

- A. Test and inspect water heater storage tanks, specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.
- B. Hydrostatically test water heater storage tanks before shipment to minimum of one and one-half times pressure rating.
- C. Prepare test reports.

PART 3 - EXECUTION

3.1 WATER HEATER INSTALLATION

- A. Install commercial water heaters on concrete bases.
 1. Exception: Omit concrete bases for commercial water heaters if installation on stand, bracket, suspended platform, or direct on floor is indicated.
 2. Concrete base construction requirements are specified in Division 20 Section "Basic Mechanical Materials and Methods."
- B. Install water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
- C. Install gas water heaters according to NFPA 54.
- D. Install gas shutoff valves on gas supplies to gas water heaters without shutoff valves.
- E. Install gas pressure regulators on gas supplies to gas water heaters without gas pressure regulators if gas pressure regulators are required to reduce gas pressure at burner.
- F. Install automatic gas valves on gas supplies to gas water heaters, if required for operation of safety control.

- G. Install combination temperature and pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater, relief-valve outlet, with drain piping same as domestic water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- H. Install pressure relief valves in water piping for water heaters without storage. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- I. Install water heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for water heaters that do not have tank drains. Refer to Division 20 Section "Valves" for hose-end drain valves.
- J. Install thermometer on outlet piping of water heaters. Refer to Division 20 Section "Meters and Gages" for thermometers.
- K. Install pressure gages on inlet and outlet piping of commercial, fuel-fired water heater piping. Refer to Division 20 Section "Meters and Gages" for pressure gages.
- L. Assemble and install inlet and outlet piping manifold kits for multiple water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each water heater. Include shutoff valve and thermometer in each water heater inlet and outlet, and throttling valve in each water heater outlet. Refer to Division 20 Section "Valves" for general-duty valves and to Division 20 Section "Meters and Gages" for thermometers.
- M. Fill water heaters with water.
- N. Install expansion tanks with isolation and drain valves. Charge expansion tanks with air.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 20 and 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to water heaters to allow service and maintenance. Arrange piping for easy removal of water heaters.
- C. Connect vent to full size of water heater flue outlet. Refer to Division 23 Section "Breechings, Chimneys, and Stacks" for venting materials.
- D. Ground equipment according to Division 26 Section "Grounding and Bonding."
- E. Connect wiring according to Division 26 Section "Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

- B. Perform the following field tests and inspections and prepare test reports:
 - 1. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, confirm proper operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Remove and replace water heaters that do not pass tests and inspections and retest as specified above.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain water heaters.

END OF SECTION 223410

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 10 Section "Toilet and Bath Accessories."
 - 2. Division 20 Section "Mechanical General Requirements."
 - 3. Division 20 Section "Basic Mechanical Materials and Methods."
 - 4. Division 22 Section "Medical Plumbing Fixtures."
 - 5. Division 22 Section "Emergency Plumbing Fixtures."
 - 6. Division 22 Section "Security Plumbing Fixtures."
 - 7. Division 22 Section "Drinking Fountains and Water Coolers."
 - 8. Division 22 Section "Domestic Water Piping Specialties" for backflow preventers; individual-fixture, water tempering valves; and specialty fixtures not included in this Section.

9. Division 22 Section "Drainage Piping Specialties" for floor drains, and specialty fixtures not included in this Section.
10. Division 22 Section "Water Distribution" for exterior plumbing fixtures and hydrants.

1.2 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
- C. Cast Polymer: Cast-filled-polymer-plastic material. This material includes cultured-marble and solid-surface materials.
- D. Cultured Marble: Cast-filled-polymer-plastic material with surface coating.
- E. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.
- F. FRP: Fiberglass-reinforced plastic.
- G. PMMA: Polymethyl methacrylate (acrylic) plastic.
- H. PVC: Polyvinyl chloride plastic.
- I. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.

1.4 INFORMATIONAL SUBMITTALS

- A. Shop Drawings: Diagram power, signal, and control wiring.
- B. Coordination Drawings: Counter cutout templates for mounting of counter-mounted plumbing fixtures.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For plumbing fixtures and trim to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.
 - 1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.
- C. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities" for plumbing fixtures for people with disabilities.
- D. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- E. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of Lead in Drinking Water Act," about lead content in materials that will be in contact with potable water for human consumption.
- F. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," and NSF 372 Drinking Water System Components - Lead Content for potable domestic water piping and components.
- G. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
- H. Comply with applicable ANSI, ASME, ASSE, ASTM, ICC, NSF, and UL standards and other requirements specified for plumbing fixtures, trim, fittings, components, and features.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

PART 2 - PRODUCTS

2.1 WATER CLOSETS

- A. Water Closets, WC-1:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Standard Companies, Inc.; Afwall Wall Hung Elongated Toilet.
 - b. Ferguson Enterprises, Inc.; ProFlo.
 - c. Kohler Co.; Kingston K-4325-0 .
 - d. Sloan Valve Company.
 - e. Zurn Plumbing Products Group; EcoVantage.

2. Description: Wall-mounting, back-outlet, vitreous-china fixture designed for flushometer valve operation.
 - a. Style: Flushometer valve.
 - 1) Bowl Type: Elongated with siphon-jet design.
 - 2) Supply Spud Location: Top .
 - 3) Design Consumption: 1.28 gal./flush or 1.6 gal./flush.
 - 4) Color: White.
 - b. Flushometer: FV-2-1.
 - c. Toilet Seat: TS-1.
 - d. Fixture Support: Water-closet support combination carrier.

B. Water Closets, WC-2:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Standard Companies, Inc.; Madera FloWise 16-1/2" Elongated Toilet.
 - b. Kohler Co.; Highcliff Ultra K-96057.
 - c. Sloan Valve Company.
 - d. Zurn Plumbing Products Group.
2. Description: Accessible, floor-mounting, floor-outlet, vitreous-china fixture designed for flushometer valve operation.
 - a. Style: Flushometer valve.
 - 1) Bowl Type: Elongated with siphon-jet design. Include bolt caps matching fixture.
 - 2) Supply Spud Location: Top.
 - 3) Height: 16-1/2 to 16-3/4 inches, universal/accessible.
 - 4) Design Consumption: 1.28 gal./flush or 1.6 gal./flush.
 - 5) Color: White.
 - b. Flushometer: FV-2-1.
 - c. Toilet Seat: TS-1.

2.2 MANUAL WATER CLOSET FLUSHOMETERS

A. Flushometers, FV-2-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Standard Companies, Inc.
 - b. Delany Products.
 - c. Delta Faucet Company; 81T201.
 - d. Kohler Co.: MACH Series.
 - e. Sloan Valve Company.
 - f. Zurn Plumbing Products Group.
2. Description: Flushometer for water-closet-type fixture. Include brass body with corrosion-resistant internal components, non-hold-open feature, control stop

with check valve, vacuum breaker, copper or brass tubing, and polished chrome-plated finish on exposed parts.

- a. Internal Design: Diaphragm or piston operation.
- b. Style: Exposed.
- c. Inlet Size: NPS 1.
- d. Trip Mechanism: Oscillating, low-force ADA compliant lever-handle actuator.
- e. Consumption: 1.6 gal./flush.
- f. Tailpiece Size: NPS 1-1/2 and standard length to top of bowl.

2.3 URINALS

A. Urinals, UR-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Standard Companies, Inc.; Washbrook Urinal System.
 - b. Kohler Co.; Bardon K 4991-ETSS.
 - c. Sloan Valve Company.
 - d. Zurn Industries, Inc.; EcoVantage.
2. Description: Wall-mounting, back-outlet, ultra-low water consumption, vitreous-china fixture designed for flushometer valve operation.
 - a. Type: High efficiency.
 - b. Strainer or Trapway: Open trapway with integral trap.
 - c. Design Consumption: Operates in the range of 1/8 gal./flush to 1 gal./flush.
 - d. Color: White.
 - e. Supply Spud Size: NPS 3/4.
 - f. Supply Spud Location: Top.
 - g. Outlet Size: NPS 2.
 - h. Flushometer: FV-1-1.
 - i. Fixture Support: Urinal chair carrier.

2.4 MANUAL URINAL FLUSHOMETERS

A. Flushometers, FV-1-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Standard Companies, Inc.
 - b. Delany Products.
 - c. Delta Faucet Company; 81T231.
 - d. Kohler Co.; MACH Series.
 - e. Sloan Valve Company.
 - f. Zurn Plumbing Products Group; Z6003-WS1.
2. Description: Flushometer for urinal-type fixture. Include brass body with corrosion-resistant internal components, non-hold-open feature, control stop with check valve, vacuum breaker, copper or brass tubing, and polished chrome-plated finish on exposed parts.
 - a. Internal Design: Diaphragm or piston operation.

- b. Style: Exposed.
- c. Inlet Size: NPS 3/4.
- d. Trip Mechanism: Oscillating, low-force ADA compliant lever-handle actuator.
- e. Consumption: 0.5 gal./flush.
- f. Tailpiece Size: NPS 3/4 and standard length to top of fixture.

2.5 TOILET SEATS

A. Toilet Seats, TS-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bemis Manufacturing Company; 1955SSC/1955SSCT.
 - b. Centoco Manufacturing Corp.
 - c. Church Seats; 295SSC/295SSCT.
 - d. Comfort Seats; a Jones Stephens Brand; Model Number C106SSC.
 - e. Ferguson Enterprises, Inc.; ProFlo PFTSCOF2000WH.
 - f. Olsonite Seat Company; Model 10SSC/10SSCT.
 - g. Plumbtech; Plumbing Technologies, LLC.
 - h. Sanderson Plumbing Products, Inc.; Beneke Div.
 - i. Zurn Plumbing Products Group; 5955STS-WH.
2. Description: Toilet seat for water-closet-type fixture.
 - a. Material: Molded, solid plastic.
 - b. Configuration: Open front without cover.
 - c. Size: Elongated.
 - d. Hinge Type: SC, self-sustaining, check. (Soft closing)
 - e. Class: Standard commercial.
 - f. Color: White.

2.6 LAVATORIES

A. Refer to specification 224216.13 Commercial Lavatories. LAV-1, 2, 3

B. Lavatories, LAV-4:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Standard Companies, Inc.; Lucerne Model 0355.012.
 - b. Ferguson Enterprises, Inc.; ProFlo PF5504.
 - c. Kohler Co.; K 2005 Kingston.
 - d. Sloan Valve Company.
 - e. Zurn Plumbing Products Group; Z5344.
2. Description: Accessible, wall-mounting, vitreous-china fixture.
 - a. Type: With contoured back and side shields.
 - b. Size: 20 by 18 inches rectangular.
 - c. Faucet Hole Punching: Three holes, 2-inch centers.
 - d. Color: White.
 - e. Faucet: LF-1
 - f. Water Temperature Limiting Device: Required.

- g. Drain: Grid.
- h. Drain Piping: NPS 1-1/4 chrome-plated, cast-brass P-trap; NPS 1-1/4, 17 gage tubular brass waste to wall; and wall escutcheon.
- i. Fixture Support: Lavatory with concealed arms.

2.7 LAVATORY FAUCETS

A. Lavatory Faucets, LF-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Kohler Co. Model K-97283-4
 - b. Or as approved by architect
2. Description: Single handle mixing faucet, vandal resistant, 2 or 3 holes, with metal grid strainer, no lift rod hole, high temperature limit stop.
 - a. Body Material: Commercial, all metal construction meeting NSF 61.
 - b. Finish: Polished chrome plate.
 - c. Centers: 4 inches.
 - d. Mounting: Deck, concealed.
 - e. Inlet(s): NPS 1/2.
 - f. Spout Outlet:
 - 1) Vandal resistant aerator.
 - 2) Laminar flow or plain end for patient care areas.
 - g. Maximum Flow Rate:
 - 1) 0.5 gpm for faucets in public restrooms.

2.8 COUNTER-MOUNTING SINKS

A. Sinks, SK-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Elkay Manufacturing Co. Model BCR15
 - b. Franke Consumer Products, Inc., Commercial Div.
 - c. Just Manufacturing Company.
 - d. Moen Commercial.
2. Description: Single-bowl, counter-mounting, lay-in stainless-steel sink.
 - a. Overall Dimensions: 15 inches left to right by 15 inches front to back.
 - b. Metal Thickness: 18 gage, with sound dampened underside.
 - c. Bowl:
 - 1) Dimensions: 12 inches by 10 inches by 6 1/8" inches deep.
 - 2) Drain: 2-inch grid.
 - d. Sink Faucet: SF-2.
 - e. Water Temperature Limiting Device: Required.

- f. Drain Piping: NPS 1-1/2 chrome-plated, cast-brass P-trap; 17 gage tubular brass waste to wall; and wall escutcheon(s).
- g. Disposer: Not required.
- h. Dishwasher Air-Gap Fitting: Not required.
- i. Hot-Water Dispenser: Not required.

B. Sinks, SK-3:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Elkay Manufacturing Co.
 - b. Franke Consumer Products, Inc., Commercial Div.
 - c. Just Manufacturing Company.
 - d. Moen Commercial.
- 2. Description: Single-bowl, deep basin, counter-mounting, lay-in stainless-steel sink.
 - a. Overall Dimensions: 22 inches left to right by 19 inches front to back.
 - b. Metal Thickness: 18 gage, with sound dampened underside.
 - c. Bowl:
 - 1) Dimensions: 18 inches by 14 inches by 10 inches deep.
 - 2) Drain: 3-1/2-inch grid
 - d. Sink Faucet: SF-2
 - e. Water Temperature Limiting Device: Required.
 - f. Drain Piping: NPS 1-1/2 chrome-plated, cast-brass P-trap; 17 gage tubular brass waste to wall; and wall escutcheon(s).
 - g. Disposer: Not required.
 - h. Dishwasher Air-Gap Fitting: Required.
 - i. Hot-Water Dispenser: Not required.

C. Commercial Sinks, CS-1:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Elkay Manufacturing Co.
 - b. Franke Consumer Products, Inc., Commercial Div.
 - c. Just Manufacturing Company.
- 2. Description: One-compartment, freestanding, Type 304 stainless-steel commercial sink with backsplash.
 - a. Overall Dimensions: 26 inches by 48 inches.
 - b. Metal Thickness: 14 gage.
 - c. Compartment:
 - 1) Dimensions: 24 inches by 24 inches by 14 inches deep.
 - 2) Drain: Grid with NPS 1-1/2 tailpiece.
 - a) Location: Centered in compartment.
 - d. Drainboard(s): NONE.
 - e. Supports: Tubular stainless steel legs with adjustable bullet shaped feet.
 - f. Faucet(s): Sink SF-1.

1) Mounting: In backsplash.

g. Drain Piping: NPS 1-1/2 chrome-plated, cast-brass P-trap; 17 gage tubular brass waste to wall; and wall escutcheon(s).

2.9 SERVICE BASINS

A. Service Basins:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acorn Engineering Company.
 - b. Crane Plumbing, LLC; Fiat Products; an American Standard Brand.
 - c. Florestone Products Co., Inc.
 - d. Precast Terrazzo Enterprises, Inc.
 - e. Stern-Williams Co., Inc.
 - f. Ferguson Enterprises, Inc.; ProFlo.
 - g. Florestone Products Co., Inc.
 - h. Mustee, E. L. & Sons, Inc.
 - i. Swan; American Bath Group.
 - j. Zurn Plumbing Products Group; Light Commercial Operation.
2. Description: Flush-to-wall, floor-mounting, precast terrazzo fixture with rim guard.
 - a. Shape: Square.
 - b. Size: 36 by 24 inches.
 - c. Height: 12 inches with dropped front .
 - d. Tiling Flange: Not required.
 - e. Rim Guard: On all top surfaces.
 - f. Color: Not applicable.
 - g. Faucet: SF-7.
 - h. Drain: Grid with NPS 3 outlet.

2.10 SINK FAUCETS

A. Sink Faucets, SF-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Standard Companies, Inc.
 - b. Chicago Faucets; No. 631-R.
 - c. Delta Faucet Company; Model 28C4934-R2.
 - d. Elkay Manufacturing Co.; LK940GNO8T4H.
 - e. Kohler Co.; K7320-4.
 - f. Moen Commercial.
 - g. Speakman Company; SC-5749.
 - h. T & S Brass and Bronze Works, Inc.
 - i. Zurn Plumbing Products Group; Z842B4.
2. Description: Commercial/Industrial sink faucet. Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.

- a. Body Material: Commercial, solid brass.
- b. Finish: Polished chrome plate.
- c. Mixing Valve: Two handle.
- d. Centers: 8 inches.
- e. Mounting: Back/wall.
- f. Handle(s): Wrist blade, 4 inches.
- g. Operation: Noncompression, manual.
- h. Inlet(s): NPS 1/2.
- i. Spout Type: 70 to 120-degree restricted swing gooseneck.
- j. Spout Outlet: Aerator.
- k. Maximum Flow Rate:
 - 1) 1.5 gpm.

B. Sink Faucets, SF-2:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Elkay model Avado single hole bar faucet with lever faucet
 - b. Or as approved by architect
- 2. Description: Sink faucet. Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.
 - a. Body Material: Commercial, solid brass.
 - b. Finish: Polished chrome plate.
 - c. Mixing Valve: single handle.
 - d. Mounting: Deck.
 - e. Handle(s): side lever.
 - f. Operation: Noncompression, manual.
 - g. Inlet(s): NPS 1/2.
 - h. Spout Type: fixed gooseneck.
 - i. Spout Outlet:
 - 1) Aerator.
 - 2) Laminar flow or plain end for patient care areas.
 - j. Maximum Flow Rate:
 - 1) 1.5 gpm.

C. Sink Faucets, SF-7:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Standard Companies, Inc.
 - b. Chicago Faucets; Model 897.
 - c. Delta Faucet Company; Model 28C2383.
 - d. Ferguson Enterprises, Inc.; ProFlo PF1118.
 - e. Kohler Co.
 - f. Moen Commercial.
 - g. Speakman Company; SC5811-RCP-LEV-5H-WHK.
 - h. Symmons Industries, Inc.
 - i. T & S Brass and Bronze Works, Inc.

- j. Zurn Plumbing Products Group.
2. Description: Service sink faucet with stops in shanks, vacuum breaker, hose-thread outlet, and pail hook. Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor. Include 5 foot rubber hose and wall mounted hose clamp.
- a. Body Material: Commercial, solid brass.
 - b. Finish: Polished chrome plate.
 - c. Maximum Flow Rate: 2.5 gpm, unless otherwise indicated.
 - d. Mixing Valve: Two handle.
 - e. Centers: 8 inches.
 - f. Mounting: Back/wall.
 - g. Handle(s): Lever.
 - h. Inlet(s): NPS 1/2.
 - i. Spout Type: Rigid, solid brass with wall brace and pail hook.
 - j. Spout Outlet: Hose thread.
 - k. Vacuum Breaker: Required.
 - l. Operation: Noncompression, manual.

2.11 PRE-RINSE UNITS

A. Pre-Rinse Unit, PRU-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- a. Chicago Faucets; No. 919-CP.
 - b. Delta Faucet Company; 55T Series.
 - c. T & S Brass and Bronze Works, Inc.
 - d. Zurn Plumbing Products Group; AquaSpec Z80000-PR1.
2. Description: Food service pre-rinse unit. Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes.
- a. Body Material: Commercial, solid brass.
 - b. Finish: Polished chrome plate.
 - c. Maximum Flow Rate: 2.5 gpm, unless otherwise indicated.
 - d. Mixing Valve: Two handle.
 - e. Centers: Single hole.
 - f. Mounting: Deck.
 - g. Handle(s): Lever.
 - h. Inlet(s): NPS 1/2.
 - i. Riser: 23 inches with spring guide.
 - j. Hose: Flexible stainless steel, 44 inches, with insulated handle.
 - k. Spray Valve: Self closing.
 - l. Operation: Noncompression, manual.

2.12 FIXTURE SUPPLIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- 1. BrassCraft; a Masco Company.
 - 2. McGuire Mfg. Co., Inc.
 - 3. Any of the approved plumbing fixture manufacturers.

- B. Description: Chrome-plated brass, loose-key or screwdriver angle stops with brass stems; rigid, chrome-plated copper risers; and chrome-plated wall flanges.

2.13 PROTECTIVE SHIELDING GUARDS

- A. Protective Shielding Pipe Covers (PSG-1):
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Engineered Brass Co.
 - b. Insul-Tect Products Co.; a Subsidiary of MVG Molded Products.
 - c. McGuire Manufacturing Co., Inc.
 - d. Oatey; Dearborn Safety Series.
 - e. Plumberex Specialty Products Inc.
 - f. TCI Products; SG-200BV.
 - g. TRUEBRO, Inc.
 - h. Zurn Plumbing Products Group; Z8946-3-NT.
 - 2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

2.14 FIXTURE SUPPORTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Josam Company.
 - 2. MIFAB Manufacturing Inc.
 - 3. Smith, Jay R. Mfg. Co.
 - 4. Tyler Pipe; Wade Div.
 - 5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
 - 6. Zurn Plumbing Products Group; Specification Drainage Operation.
- B. Water-Closet Supports:
 - 1. Description: Combination carrier designed for wall-mounting, water-closet-type fixture. Include:
 - a. Single or double, vertical or horizontal, hub-and-spigot or hubless waste fitting as required for piping arrangement.
 - b. Faceplates; couplings with gaskets; feet; and fixture bolts and hardware matching fixture.
 - c. Cast iron nipple and coupling kit.
 - d. Additional extension coupling, faceplate, and feet for installation in wide pipe space.
- C. Urinal Supports:
 - 1. Description: For wall-mounting, urinal-type fixture. Include steel uprights with feet.
 - 2. Accessible-Fixture Support: Include rectangular steel uprights.
- D. Lavatory Supports:

1. Description: Lavatory carrier with concealed arms and tie rods for wall-mounting, lavatory-type fixture. Include steel uprights with feet.
 2. Accessible-Fixture Support: Include rectangular steel uprights.
- E. Sink Supports:
1. Description: For wall-mounting sink-type fixture. Include steel uprights with feet.
 - a. Type I, sink carrier with exposed arms and tie rods.
 - b. Type II, sink carrier with hanger plate, bear studs, and tie rod.
 - c. Type III, sink carrier with hanger plate and exposed arms.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.
- B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.
- B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.
 1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
 2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
 3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
- C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.
- D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.
- E. Install wall-mounting fixtures with tubular waste piping attached to supports.
- F. Install wall-mounting urinals with PVC-DWV piping from urinal outlet to first change in piping direction.
- G. Install counter-mounting fixtures in and attached to casework.
- H. Install fixtures level and plumb according to roughing-in drawings. Install accessible fixtures at heights required by local codes.
- I. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe

spaces behind fixtures. Install stops in locations where they can be easily reached for operation.

1. Exception: Fixtures with flushometer valves, and faucets or valves with integral stops.
- J. Install ASSE 1070 water-temperature limiting devices on supplies for lavatories and sinks that will be used for handwashing, and where specified. Refer to Division 20 Section "Domestic Water Piping Specialties."
- K. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
- L. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
- M. Install protective shielding guards PSG-1 on exposed traps and supplies of lavatories, and sinks used for hand washing.
- N. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.
- O. Install toilet seats on water closets.
- P. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- Q. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.
- R. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- S. Install shower flow-control fittings with specified maximum flow rates in shower arms.
- T. Install traps on fixture outlets.
1. Exception: Omit trap on fixtures with integral traps.
 2. Exception: Omit trap on indirect wastes, unless otherwise indicated.
- U. Install disposer in outlet of each sink indicated to have disposer. Install switch where indicated or in wall adjacent to sink if location is not indicated.
- V. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 20 Section "Basic Mechanical Materials and Methods."
- W. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 20 and 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- C. Individual water line branches, waste lines, vents, and traps for connection to individual fixtures, fixture fittings and specialties shall be in accordance with the schedule on the Drawings.
- D. Ground equipment according to Division 26 Section "Grounding and Bonding."
- E. Connect wiring according to Division 26 Section "Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.
- B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.
- C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.
- D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

3.5 ADJUSTING

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
- B. Replace washers and seals, or cartridges of leaking and dripping faucets and stops.

3.6 CLEANING

- A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:
 - 1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
 - 2. Remove sediment and debris from drains.
- B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

3.7 PROTECTION

- A. Provide protective covering for installed fixtures and fittings.

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- B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224200

SECTION 224216.13 - COMMERCIAL LAVATORIES

Reissued for addendum #2

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:
a. Lavatories

LAV-1

Lavatory system *LAV-1*: Solid surface side by side hand wash stations.

Basis of Design Product: Subject to compliance with requirements, provide Sloan Valve Company: Contact: Kim Jennings (Diversified Spec. Sales, Inc.) Sloan Designer Series Sink model no. DSG 84000 Gradient Style Sink. Product to be fabricated out of Corian. Faucet (By Others). Sink design to be ADA compliant and IAPMO certified. Supplied with stainless steel *trash enclosure and high pressure laminate option*

Product: DSG 84000

Standard: Meets or exceeds ASME A112.18.1/CSA B125.1, ANSI A117.1, IGC156, CSA B45.5/IAPMO Z124, NSF 371, UL499

Bowl & Counter: 4 station w/individual stations. Include (two) trash holes

Standard: ICPA SS-1 for solid-surface bowls.

Height to Rim: 34 inches above floor. Standard 34" ADA 33", 838 mm according to ICC.A117.1

Color or Finish: Corian Color = Savannah

Corian: <https://www.na.corian.com/>

Material: Corian Solid Surface

Laminate front material: Arborite/copper artisan walnut W2003 AW

Overall Dimensions: 4 station 196" by 24" by 22" inches confirm dimensions with architect before ordering

Access Panel: 16-1/8" inch (410 mm) access panel

Mounting: Wall hung. Carrier not required when using mounting brackets or mounting frame.

Number of Stations: Four individual stations.

Drain: Grid with NPS 1-1/2 (DN 40) tailpiece, each bowl.

Drain Finishes: Polished Chrome Plated

Faucet: see lav-1 faucet in 224000

Lavatory system: Solid surface side by side hand wash stations.

Basis of Design Product: Subject to compliance with requirements, provide Sloan Valve Company: Contact: Kim Jennings (Diversified Spec. Sales, Inc.) Sloan Designer Series Sink model no. DSG 83000 Gradient Style Sink. Product to be fabricated out of Corian. Faucet (By Others). Sink design to be ADA compliant and IAPMO certified. *Supplied with stainless steel enclosure for the trash bin and HPL for the apron fronts*

Product: DSG 83000

Standard: Meets or exceeds ASME A112.18.1/CSA B125.1, ANSI A117.1, IGC156, CSA B45.5/IAPMO Z124, NSF 371, UL499

Electrical Components: Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

Bowl & Counter: DSG 83000 3 station w/individual stations. Include (two) trash holes

Standard: ICPA SS-1 for solid-surface bowls.

Height to Rim: 34 inches above floor. Standard 34" ADA 33" Child 29-7/8", according to ICC.A117.1

Color or Finish: Corian Color = *Savannah HPL color Arborite Copper Artisian Walnut W2003 AW*

Corian: <https://www.na.corian.com/>

Material: Corian Solid Surface

Overall Dimensions: *4 station refer to architectural plans for length*

Access Panel: 16-1/8" inch (410 mm) access panel

Mounting: Wall hung. Carrier not required when using mounting brackets or mounting frame.

Number of Stations: **Three** individual stations.

Drain: Grid with NPS 1-1/2 (DN 40) tailpiece, each bowl.

Drain Finishes: Polished Chrome Plated

Faucet: see lav-1 faucet specification 224000

LAV-2

Lavatory system T.1: Solid surface side by side hand wash stations.

Basis of Design Product: Subject to compliance with requirements, provide Sloan Valve Company: Contact: Kim Jennings (Diversified Spec Sales, Inc.) 586-612-2961. Sloan Designer Series Sink model no. DSG 82000 Gradient Style Sink. Product to be fabricated out of Corian. Faucet (By Others). Sink design to be ADA compliant and IAPMO certified. Supplied with angle brackets or enclosure. *Supplied with stainless steel enclosure for the trash bin and HPL for the apron fronts*

Product: DSG 82000

Standard: Meets or exceeds ASME A112.18.1/CSA B125.1, ANSI A117.1, IGC156, CSA B45.5/IAPMO Z124, NSF 371, UL499

Electrical Components: Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

Bowl & Counter: DSG 82000 w/1 trash hole

Standard: ICPA SS-1 for solid-surface bowls.

Height to Rim: 34 inches above floor. Standard 34" ADA 33", Child 29-7/8", according to ICC.A117.1

Color or Finish: *Savannah HPL color Arborite Copper Artisian Walnut W2003 AW*

Corian: <https://www.na.corian.com/>

Material: Corian Solid Surface

Overall Dimensions: 2 station wall to wall refer to architectural floor plans for length

Access Panel: 16-1/8" inch (410 mm) access panel.

Mounting: Wall hung. Carrier not required when using mounting brackets or mounting frame.

Number of Stations: Two w/1 Trash Hole.

Drain: Grid with NPS 1-1/2 (DN 40) tailpiece, each bowl.

Drain Finishes: Polished Chrome Plated

Faucet: see lav-1 faucet specification 224000

LAV-3

Lavatory system 29/A8.02: Solid surface side by side hand wash stations.

Basis of Design Product: Subject to compliance with requirements, provide Sloan Valve Company: Contact: Kim Jennings (Diversified Spec Sales, Inc.) 586-612-2961. Sloan Designer Series Sink model no. DSG 81000 Gradient Style Sink. Product to be fabricated out of Corian. Faucet (By Others). Sink design to be ADA compliant and IAPMO certified. Supplied with angle brackets or enclosure. *Supplied with stainless steel enclosure for the trash bins and HLP for the apron front*

Product: DSG 81000

Standard: Meets or exceeds ASME A112.18.1/CSA B125.1, ANSI A117.1, IGC156, CSA B45.5/IAPMO Z124, NSF 371, UL499

Electrical Components: Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

Bowl & Counter: DSG 81000 One Station

Standard: ICPA SS-1 for solid-surface bowls.

Height to Rim: 34 inches above floor. Standard 34" ADA 33", Child 29-7/8", according to ICC.A117.1

Color or Finish: Savannah

Corian: <https://www.na.corian.com/>

Material: Corian Solid Surface

Overall Dimensions: 1 station 30" by 23.5" by 22" inches.

Access Panel: 16-1/8" inch access panel.

Mounting: Wall hung. Carrier not required when using mounting brackets or mounting frame.

Number of Stations: One

Drain: Grid with NPS 1-1/2 (DN 40) tailpiece, each bowl.

Drain Finishes: Polished Chrome Plated

Faucet: see lav-1 faucet specification 224000

SECTION 224700 - DRINKING FOUNTAINS, WATER COOLERS, AND CUSPIDORS

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."

1.2 DEFINITIONS

- A. Accessible Drinking Fountain or Water Cooler: Fixture that can be approached and used by people with disabilities.
- B. Cast Polymer: Dense, cast-filled-polymer plastic.
- C. Drinking Fountain: Fixture with nozzle for delivering stream of water for drinking.
- D. Fitting: Device that controls flow of water into or out of fixture.
- E. Fixture: Drinking fountain or water cooler.
- F. Remote Water Cooler: Electrically powered equipment for generating cooled drinking water.
- G. TDS: Total dissolved solids.

- H. Water Cooler: Electrically powered fixture for generating and delivering cooled drinking water.

1.3 ACTION SUBMITTALS

- A. Product Data: For each fixture indicated. Include rated capacities, furnished specialties, and accessories.

1.4 INFORMATIONAL SUBMITTALS

- A. Shop Drawings: Diagram power, signal, and control wiring.

1.5 CLOSEOUT SUBMITTALS

- A. Field quality-control test reports.
- B. Operation and Maintenance Data: For fixtures to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a NRTL acceptable to authorities having jurisdiction, and marked for intended use.
- B. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities" for fixtures for people with disabilities.
- C. Regulatory Requirements: Comply with requirements in the U.S. Architectural & Transportation Barriers Compliance Board's "Uniform Federal Accessibility Standards (UFAS), 1985-494-187" about fixtures for people with disabilities.
- D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 and NSF 372.
- E. AHRI Standard: Comply with AHRI's "Directory of Certified Drinking Water Coolers" for style classifications.
- F. ASHRAE Standard: Comply with ASHRAE 34, "Designation and Safety Classification of Refrigerants," for water coolers. Provide HFC 134a (tetrafluoroethane) refrigerant, unless otherwise indicated.

PART 2 - PRODUCTS

2.1 PRESSURE (ELECTRIC) WATER COOLERS

- A. Water Coolers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Elkay Manufacturing Co.; EZWS-SFGRN28K.
 - b. Halsey Taylor.
 - c. Haws Corporation.
 - d. Murdock Manufacturing; A Member of Morris Group International.
 - e. Oasis Corporation.
 - f. Sunroc Corp.
2. Description: AHRI 1010, Type PB, pressure with bubbler, accessible, Style W, dual-height, architectural-style wall-mounting water cooler with bottle filling station.
- a. Material: Stainless steel.
 - b. Receptor Shape: Round.
 - c. Back Panel: Stainless-steel behind receptors with ventilation grille located below receptors.
 - d. Bubblers: One for each receptor, flexible or elastomeric overmolded, with adjustable stream regulator, located on receptors.
 - e. Control: Push button.
 - f. Supply: NPS 3/8 with isolation valve.
 - g. Drain: Grid with NPS 1-1/4 minimum horizontal waste and trap complying with ASME A112.18.2.
 - h. Cooling System: Electric, with hermetically sealed compressor, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, refrigerant, corrosion-resistant-metal storage tank, and adjustable thermostat.
 - 1) Capacity: 8 gph of 50 deg F cooled water from 80 deg F inlet water and 90 deg F ambient air temperature.
 - 2) Electrical Characteristics: 1/5 hp; 120-V ac; single phase; 60 Hz.
 - i. Bottle Filling Station: Recessed design constructed of 18 gage Type 300 series stainless steel and ABS plastic. Include:
 - 1) Electronic sensor for no-touch activation.
 - 2) Automatic 20-second shut-off timer.
 - 3) 1.1 gpm flow rate
 - 4) Anti-microbial protected plastic components.
 - j. Support: Refer to "Fixture Supports" Article.

2.2 FIXTURE SUPPORTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Josam Co.
 2. MIFAB Manufacturing, Inc.
 3. Smith, Jay R. Mfg. Co.; A Member of Morris Group International.
 4. Tyler Pipe; Wade Div.
 5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
 6. Zurn Plumbing Products Group; Specification Drainage Operation.
- B. Description: ASME A112.6.1M, water cooler carriers. Include vertical, steel uprights with feet and tie rods and bearing plates with mounting studs matching fixture to be supported.
1. Type I: Hanger-type carrier with two vertical uprights.
 2. Type II: Bilevel, hanger-type carrier with three vertical uprights.

3. Supports for Accessible Fixtures: Include rectangular, vertical, steel uprights instead of steel pipe uprights.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for water and waste piping systems to verify actual locations of piping connections before fixture installation. Verify that sizes and locations of piping and types of supports match those indicated.
- B. Examine walls and floors for suitable conditions where fixtures are to be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Use carrier off-floor supports for wall-mounting fixtures, unless otherwise indicated.
- B. Use mounting frames for recessed water coolers, unless otherwise indicated.
- C. Set freestanding and pedestal drinking fountains on floor.
- D. Set remote water coolers on floor, unless otherwise indicated.
- E. Use chrome-plated brass or copper tube, fittings, and valves in locations exposed to view. Plain copper tube, fittings, and valves may be used in concealed locations.

3.3 INSTALLATION

- A. Install off-floor supports affixed to building substrate and attach wall-mounting fixtures, unless otherwise indicated.
- B. Install mounting frames affixed to building construction and attach recessed water coolers to mounting frames, unless otherwise indicated.
- C. Install fixtures level and plumb. For fixtures indicated for children, install at height required by authorities having jurisdiction.
- D. Install water-supply piping with shutoff valve on supply to each fixture to be connected to water distribution piping. Install valves in locations where they can be easily reached for operation. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing."
- E. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.
- F. Install pipe escutcheons at wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding pipe fittings. Escutcheons are specified in Division 20 Section "Basic Mechanical Materials and Methods."

- G. Seal joints between fixtures and walls and floors using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

3.4 CONNECTIONS

- A. Piping installation requirements are specified in other Division 20 and 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding."
- D. Connect wiring according to Division 26 Section "Conductors and Cables."

3.5 FIELD QUALITY CONTROL

- A. Water Cooler Testing: After electrical circuitry has been energized, test for compliance with requirements. Test and adjust controls and safeties.
 - 1. Remove and replace malfunctioning units and retest as specified above.
 - 2. Report test results in writing.

3.6 ADJUSTING

- A. Adjust fixture flow regulators for proper flow and stream height.
- B. Adjust water cooler temperature settings.

3.7 CLEANING

- A. After completing fixture installation, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.
- B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.

END OF SECTION 224700

SECTION 230500 - COMMON WORK RESULTS FOR HVAC

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."
 - 3. Division 23 Section "Testing, Adjusting, and Balancing."

1.2 SUMMARY

- A. This Section includes common requirements for fans and air moving equipment.

1.3 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Fan bearings.
 - 2. V-belt fan drives.
 - 3. Direct drive couplings.

1.4 QUALITY ASSURANCE

- A. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are

appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

- B. Fan Performance Data: AMCA Standard 210.
- C. Sound Power Level Ratings:
 - 1. Ducted Fans - Rated per AMCA 301, when tested per AMCA 300.
 - 2. Nonducted Fans - Rated in Zones at 5 feet from acoustic center of fan rated per AMCA 301, tested per AMCA 300 and converted per AMCA 302.

1.5 ENVIRONMENTAL REQUIREMENTS

- A. Do not operate equipment for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 FAN SHAFTS

- A. Fan Shafts: Ground from solid cold rolled steel, and proportioned to run at least 25 percent below the first critical speed.

2.3 FAN DRIVE, SHAFT, AND COUPLING GUARDS

- A. Safety Provisions: Include guards and screens for power transmission equipment, but do not negate vibration isolation provision.
- B. Furnish ANSI and OSHA compliant mechanical power transmission apparatus guards except where superseded by other governing codes, and except as modified and supplemented. Requirements specified apply to all types of fans.
- C. Fabricate mechanical power transmission device guards such that the completed structure is capable of withstanding a load of at least 200 pounds applied in any direction.
- D. Furnish a guard enclosure for each V-belt drive, coupling, shaft, and rotating component. Secure guards in place, easily removable for maintenance. Guard fasteners used for maintenance access shall be "captive type." Locate holes on each guard for tachometer readings on both the motor and fan shafts. Fabricate guard of minimum 16 gage sheet metal with hemmed edges at openings for shafts. Weld four mounting lugs or feet of 10 gage material to the guard. Fabricate guards for

couplings five inches in diameter and larger of 12 gage sheet metal. Furnish holes in mounting feet sized for suitable machine screws.

- E. Centrifugal exhaust fans shall be provided with shaft seals.

2.4 FLEXIBLE COUPLINGS (DIRECT DRIVE)

- A. Fan shaft shall be connected to the motor shaft through a flexible coupling. The flexible member shall be a tire shape, in shear, or a solid mass serrated edge disc shape, made of chloroprene materials and retained by fixed flanges. Flexible coupling shall act as a dielectric connector and shall not transmit sound, vibration or end thrust.
- B. Manufacturer:
 - 1. Falk Corporation (The).

2.5 MOTOR REQUIREMENTS

- A. Furnish motors in accordance with Division 20 Section "Motors."

2.6 FAN BEARINGS

- A. Bearings: Anti-friction ball or roller type with provision for self-alignment and thrust load. Made in U.S.A. with ABMA L₁₀ minimum life of 200,000 hours. Use cast iron housings and dust-tight seals suitable for lubricant pressures.
 - 1. Lubrication Provisions - Use surface ball check type supply fittings. Provide extension tubes to allow safe maintenance while equipment is operating. Provide manual or automatic pressure relief fittings to prevent overheating or seal blow-out due to excess lubricant or pressure. Arrange relief fittings opposite supply but visible for normal maintenance observation.
 - 2. Bearings on Equipment with less than 1/2 horsepower rating or on shafts smaller than 1-3/4 inch in diameter: Permanently sealed, pre-lubricated anti-friction bearings per specified materials and ABMA L₁₀ life requirements.

2.7 IDENTIFICATION

- A. Nameplate: Affix metallic, corrosion-resistant data plate for each fan in a conspicuous location. Include selection point capacity conditions.

2.8 ACCESSORIES

- A. Bird Screens: Of material to match adjacent contact construction, 1/2 inch mesh or equal expanded metal. Use on inlet or outlet of each nonducted fan.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Field Rigging: Do not negate balancing. Do not bend shaft. Use lifting eyes.
- B. Install sheaves where recommended by Testing, Adjusting, and Balancing agency.
- C. Refer to individual Division 23 HVAC equipment Sections for additional requirements.

END OF SECTION 230500

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical Identification" for valve tags and charts.
 - 2. Division 21 fire-suppression piping and fire pump Sections for fire-protection valves.
 - 3. Division 22 Section "General-Duty Valves for Plumbing" for plumbing valves.
 - 4. Division 23 Section "Temperature Controls" for control valves and actuators.

1.2 SUMMARY

- A. This Section includes valves for general HVAC applications. Refer to piping Sections for specialty valve applications.

1.3 DEFINITIONS

- A. The following are standard abbreviations for valves:
 - 1. CWP: Cold working pressure.
 - 2. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - 3. NBR: Acrylonitrile-butadiene rubber.

4. NRS: Nonrising stem.
5. OS&Y: Outside screw and yoke.
6. PTFE: Polytetrafluoroethylene plastic.
7. RPTFE: Reinforced polytetrafluoroethylene plastic.
8. SWP: Steam working pressure.
9. TFE: Tetrafluoroethylene plastic.
10. WOG: Water, oil, and gas.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating valve and its application. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.

1.5 QUALITY ASSURANCE

- A. ASME Compliance: ASME B31.9 for building services piping valves.
- B. ASME Compliance for Ferrous Valves: ASME B16.10 and ASME B16.34 for dimension and design criteria.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 1. Protect internal parts against rust and corrosion.
 2. Protect threads, flange faces, grooves, and weld ends.
 3. Set angle, gate, and globe valves closed to prevent rattling.
 4. Set ball and plug valves open to minimize exposure of functional surfaces.
 5. Set butterfly valves closed or slightly open.
 6. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
 1. Maintain valve end protection.
 2. Store valves indoors and maintain at higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 VALVES, GENERAL

- A. Isolation valves are scheduled on the Drawings. For other general HVAC valve applications, use the following:
 1. Throttling Service: Angle, ball, butterfly, or globe valves.

2. Pump Discharge: Spring-loaded, lift-disc check valves; and bronze lift check valves.
 - B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
 - C. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.
 - D. For valves not indicated in the Application Schedules, select valves with the following end connections:
 1. For Copper Tubing, NPS 2 and Smaller: Solder-joint or threaded ends, except provide valves with threaded ends for condenser water, heating hot water, steam, and steam condensate services.
 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged, solder-joint, or threaded ends.
 3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
 4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
 5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends.
 6. For Steel Piping, NPS 5 and Larger: Flanged ends.
 7. For Grooved-End Systems: Valve ends may be grooved. Do not use for steam or steam condensate piping.
 - E. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.
 - F. Valve Sizes: Same as upstream pipe, unless otherwise indicated.
 - G. Valve Actuators:
 1. Chainwheel: For attachment to valves, of size and mounting height, as indicated in the "Valve Installation" Article in Part 3.
 2. Gear Drive Operator: For quarter-turn valves NPS 8 and larger.
 3. Handwheel: For valves other than quarter-turn types.
 4. Lever Handle: For quarter-turn valves NPS 6 and smaller.
 - H. Extended Valve Stems: On insulated valves.
 - I. Valve Flanges: ASME B16.1 for cast-iron valves, ASME B16.5 for steel valves, and ASME B16.24 for bronze valves.
 - J. Solder Joint: With sockets according to ASME B16.18.
 1. Caution: Disassemble valves when soldering, as recommended by the manufacturer, to prevent damage to internal parts.
 - K. Threaded: With threads according to ASME B1.20.1.
 - L. Valve Bypass and Drain Connections: MSS SP-45.
- 2.2 BRONZE BALL VALVES
- A. Bronze Ball Valves, General: MSS SP-110 and have bronze body complying with ASTM B 584, except for Class 250 which shall comply with ASTM B 61, full-depth ASME B1.20.1 threaded or solder ends, and blowout-proof stems.

- B. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim: Type 316 stainless-steel ball and stem, reinforced TFE seats, blow-out-proof stem, with adjustable stem packing, soldered or threaded ends; 150 psig SWP and 600-psig CWP ratings.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; by Conbraco Industries, Inc.; Series 77C-A Series.
 - b. Crane Co.; Crane Valves.
 - c. Hammond Valve.
 - d. Kitz Corporation; Kitz Valves.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.; Models S-585-70-66 or T-585-70-66.
 - g. Watts Water Technologies, Inc.; Series B6080G2/B6081G2.

2.3 GENERAL SERVICE BUTTERFLY VALVES

- A. General: MSS SP-67, for bubble-tight shutoff, extended-neck for insulation, disc and lining suitable for potable water, unless otherwise indicated, and with the following features:
 - 1. Full lug, and grooved valves shall be suitable for bi-directional dead end service at full rated pressure without the use or need of a downstream flange.
 - 2. Valve sizes NPS 2 through NPS 6 shall have lever lock operator; valve sizes NPS 8 and larger shall have weatherproof gear operator.
- B. Lug-Style (Single-Flange) Size NPS 2-1/2 through NPS 12 , 200-psig CWP Rating, Aluminum-Bronze Disc, EPDM Seat, Ferrous-Alloy Butterfly Valves: Full-lug type with ductile-iron body, Type 416 stainless-steel stem, copper bushing, aluminum-bronze disc, and molded-in EPDM seat (liner).
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; by Conbraco Industries, Inc.; Series 143 and Series LD 145.
 - b. Bray International, Inc.
 - c. DeZurik.
 - d. Emerson Automation Solutions; Keystone.
 - e. Forum Energy Technologies; ABZ Valve.
 - f. Hammond Valve.
 - g. Milwaukee Valve Company.
 - h. NIBCO INC.; LD-2000-3/5.
 - i. Tyco Flow Control; Grinnell Flow Control.
 - j. Watts Water Technologies.

2.4 BRONZE CHECK VALVES

- A. Bronze Check Valves, General: MSS SP-80.
- B. Class 150, Bronze, Swing Check Valves with Bronze Disc: ASTM B-62 bronze body and seat with regrinding-type bronze disc, Y-pattern design, soldered or threaded end connections, and having 300 psig CWP rating.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Apollo Valves; by Conbraco Industries, Inc.
- b. Crane Co.; Crane Valves.
- c. Crane Co.; Stockham Div.
- d. Hammond Valve.
- e. Milwaukee Valve Company; Model 515.
- f. NIBCO INC.; Models S-433-B or T-433-B.
- g. Watts Water Technologies.

2.5 IRON SWING CHECK VALVES

- A. Iron Swing Check Valves, General: MSS SP-71.
- B. Class 125, Gray-Iron, Standard Swing Check Valves: ASTM A-126, Class B cast-iron body and bolted bonnet with flanged end connections; non-asbestos synthetic-fiber gaskets; bronze disc and seat; and having 200 psig CWP rating.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; by Conbraco Industries, Inc.
 - b. Crane Co.; Crane Valves.
 - c. Crane Co.; Stockham Div.
 - d. Hammond Valve.
 - e. Milwaukee Valve Company; Model F-2974.
 - f. NIBCO INC.; Model F-918-B.
 - g. Watts Water Technologies.

2.6 BRONZE OR STAINLESS STEEL LIFT CHECK VALVES

- A. Class 125, Lift Check Valves with Nonmetallic Disc:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bonomi USA, Inc.; Series S800.
 - b. Hammond Valve.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.; Model S-480-Y or T-480-Y.
 - e. The Wm. Powell Company.
 2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 250 psig.
 - c. Body Design: Vertical flow.
 - d. Body Material: ASTM B 584 Alloy C844 bronze; or ASTM A351-CF8M stainless steel.
 - e. Ends: Threaded or Solder.
 - f. Disc: PTFE, or TFE.

2.7 SPRING-LOADED, CENTER-GUIDED LIFT-DISC (SILENT) CHECK VALVES

- A. Lift-Disc Check Valves, General: FCI 74-1 and MIL-V-18436F, with spring-loaded, center-guided bronze disc and seat.

- B. Class 125, Wafer, Lift-Disc Check Valves: Wafer style with cast-iron body with diameter made to fit within bolt circle, and having 200 psig CWP rating.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. NIBCO INC.; Model W-910-B.
 - b. Mueller Steam Specialty.
 - c. Milwaukee Valve Company.
 - d. Hammond Valve.

- C. Class 250, Wafer, Lift-Disc Check Valves: Wafer style with cast-iron body with diameter made to fit within bolt circle, and having 400 psig CWP rating.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. NIBCO INC.; Model W-960-B.
 - b. Mueller Steam Specialty.
 - c. Milwaukee Valve Company.
 - d. Hammond Valve.

- D. Class 125, Globe, Flanged Lift-Disc Check Valves: Globe style with cast-iron body and flanged ends, and having 200 psig CWP rating.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. NIBCO INC.; Model F-910-B.
 - b. Mueller Steam Specialty.
 - c. Milwaukee Valve Company.
 - d. Hammond Valve.

- E. Class 250, Globe, Flanged Lift-Disc Check Valves: Globe style with cast-iron body and flanged ends, and having 400 psig CWP rating.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. NIBCO INC.; Model F-960-B.
 - b. Mueller Steam Specialty.
 - c. Milwaukee Valve Company.
 - d. Hammond Valve.

2.8 DRAIN VALVES

- A. Ball-Valve-Type, Hose-End Drain Valves:
 - 1. Bronze ball valve as specified in this Section.
 - 2. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- C. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- D. Examine threads on valve and mating pipe for form and cleanliness.
- E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- F. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

- A. Piping installation requirements are specified in other Division 20 and 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- C. Locate valves for easy access and provide separate support where necessary.
- D. Install valves in horizontal piping with stem at or above center of pipe. Butterfly valves shall be installed with stem horizontal to allow support for the disc and the cleaning action of the disc.
- E. Install valves in position to allow full stem movement.
- F. Install chainwheel operators on valves NPS 4 and larger and more than 84 inches above floor. Extend chains to 60 inches above finished floor elevation.
- G. Install check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level.
 - 2. Dual-Plate Check Valves: In horizontal or vertical position, between flanges.
 - 3. Lift Check Valves: With stem upright and plumb.

3.3 JOINT CONSTRUCTION

- A. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.

3.4 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

END OF SECTION 230523

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING

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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.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."
 - 3. Division 23 Section "Common Work Results for HVAC."

1.2 SUMMARY

- A. This Section includes testing, adjusting, and balancing to produce design objectives for the following:

1. Air Systems:
 - a. Constant-volume air systems.
 - b. Variable-air-volume systems.
 2. Hydronic Piping Systems:
 - a. Constant-flow systems.
 - b. Variable-flow systems.
 - c. Primary-secondary systems.
 3. HVAC equipment quantitative-performance settings.
 4. Verifying that automatic control devices are functioning properly.
 5. Reporting results of activities and procedures specified in this Section.
- B. Include rebalancing of air systems, or system portions affected by recommended sheave changes.

1.3 DEFINITIONS

- A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.
- B. AHJ: Authority having jurisdiction.
- C. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to indicated quantities.
- D. Barrier or Boundary: Construction, either vertical or horizontal, such as walls, floors, and ceilings that are designed and constructed to restrict the movement of airflow, smoke, odors, and other pollutants.
- E. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.
- F. NC: Noise criteria.
- G. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.
- H. RC: Room criteria.
- I. Report Forms: Test data sheets for recording test data in logical order.
- J. Smoke-Control System: An engineered system that uses fans to produce airflow and pressure differences across barriers to limit smoke movement.
- K. Smoke-Control Zone: A space within a building that is enclosed by smoke barriers and is a part of a zoned smoke-control system.
- L. Stair Pressurization System: A type of smoke-control system that is intended to positively pressurize stair towers with outdoor air by using fans to keep smoke from contaminating the stair towers during an alarm condition.

- M. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.
- N. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.
- O. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- P. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.
- Q. TAB: Testing, adjusting, and balancing.
- R. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.
- S. Test: A procedure to determine quantitative performance of systems or equipment.
- T. Testing, Adjusting, and Balancing (TAB) Firm: The entity responsible for performing and reporting TAB procedures.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: Within 15 days from Contractor's Notice to Proceed, submit 2 copies of evidence that TAB firm and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Contract Documents Examination Report: Within 15 days from Contractor's Notice to Proceed, submit 2 copies of the Contract Documents review report as specified in Part 3.
- C. Strategies and Procedures Plan: Within 30 days from Contractor's Notice to Proceed, submit 2 copies of TAB strategies and step-by-step procedures as specified in Part 3 "Preparation" Article. Include a complete set of report forms intended for use on this Project.
- D. Sample Report Forms: Submit two sets of sample TAB report forms.

1.5 CLOSEOUT SUBMITTALS

- A. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.
- B. Warranties specified in this Section.

1.6 QUALITY ASSURANCE

- A. TAB Firm Qualifications: Engage a TAB firm certified by either AABC or NEBB.
- B. Smoke Control System Testing: Additional Qualifications: The TAB firm shall be a qualified special inspector for the smoke control systems. The TAB firm for the smoke

control system shall have expertise in fire protection engineering, mechanical engineering, and certification as air balancers.

C. Approved Balancing Agencies.

1. The TAB firm selected shall be from the following list:

- a. Airflow Testing Inc.; Lincoln Park, MI.
- b. Barmatic Inspecting Co., Inc.; Lincoln Park, MI.
- c. Ener-Tech Testing; Holly, MI.
- d. Enviro-Aire/Total Balance Co.; St. Clair Shores, MI.
- e. International Test & Balance Inc.; Southfield, MI.
- f. Quality Air Service; Portage, MI.
- g. Third Coast Test and Balance
- h. Pro-MEC Engineering Services, Inc.; Grand Ledge, MI.
- i. Hi-Tech Test & Balance; Freeland, MI.

D. TAB Conference: Meet with Owner's and Architect's representatives on approval of TAB strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of TAB team members, equipment manufacturers' authorized service representatives, HVAC controls installers, and other support personnel. Provide seven days' advance notice of scheduled meeting time and location.

1. Agenda Items: Include at least the following:

- a. Submittal distribution requirements.
- b. The Contract Documents examination report.
- c. TAB plan.
- d. Work schedule and Project-site access requirements.
- e. Coordination and cooperation of trades and subcontractors.
- f. Coordination of documentation and communication flow.

E. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:

1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.

F. TAB Report Forms: Use standard forms from AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems." TAB firm's forms approved by Architect.

G. Instrumentation Type, Quantity, and Accuracy: As described in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."

H. Instrumentation Calibration: Calibrate instruments at least every six months or more frequently if required by instrument manufacturer.

1. Keep an updated record of instrument calibration that indicates date of calibration and the name of party performing instrument calibration.

1.7 PROJECT CONDITIONS

- A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.8 COORDINATION

- A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.
- B. Notice: Provide seven days advance notice for each test. Include scheduled test dates and times.
- C. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.9 WARRANTY

- A. National Project Performance Guarantee: If AABC standards are used, provide a guarantee on AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" forms stating that AABC will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee includes the following provisions:
 - 1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
 - 2. Systems are balanced to optimum performance capabilities within design and installation limits.
- B. Special Guarantee: If NEBB standards are used, provide a guarantee on NEBB forms stating that NEBB will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee shall include the following provisions:
 - 1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
 - 2. Systems are balanced to optimum performance capabilities within design and installation limits.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.
- B. Examine system and equipment test reports.

- C. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- D. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- E. Examine terminal units, such as variable-air-volume boxes, to verify that they are accessible and their controls are connected and functioning.
- F. Examine plenum ceilings used for supply air to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.
- G. Examine strainers for clean screens and proper perforations.
- H. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.
- I. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- J. Examine system pumps to ensure absence of entrained air in the suction piping.
- K. Examine equipment for installation and for properly operating safety interlocks and controls.
- L. Examine automatic temperature system components to verify the following:
 - 1. Dampers, valves, and other controlled devices are operated by the intended controller.
 - 2. Dampers and valves are in the position indicated by the controller.
 - 3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
 - 4. Automatic modulating and shutoff valves, including two-way valves and three-way mixing and diverting valves, are properly connected.
 - 5. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
 - 6. Sensors are located to sense only the intended conditions.
 - 7. Sequence of operation for control modes is according to the Contract Documents.
 - 8. Controller set points are set at indicated values.
 - 9. Interlocked systems are operating.
 - 10. Changeover from heating to cooling mode occurs according to indicated values.
- M. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.

- B. Perform the following field tests and inspections according to SMACNA's "HVAC Air Duct Leakage Test Manual" and prepare test reports:
 - 1. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If pressure classes are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven days' advance notice for testing.
 - 2. Maximum Allowable Leakage: Leakage rates are scheduled on the Drawings.
- C. Complete system readiness checks and prepare system readiness reports. Verify the following:
 - 1. Permanent electrical power wiring is complete.
 - 2. Hydronic systems are filled, clean, and free of air.
 - 3. Automatic temperature-control systems are operational.
 - 4. Equipment and duct access doors are securely closed.
 - 5. Balance, smoke, and fire dampers are open.
 - 6. Isolating and balancing valves are open and control valves are operational.
 - 7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
 - 8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and this Section.
- B. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, to show final settings.
- C. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts, or use reduced scale contract documents with notations.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct airflow measurements.
- E. Cut insulation, and drill ducts for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes with neat patches, neoprene plugs, threaded plugs, or threaded twist-on metal caps, and patch insulation with new materials identical to those

removed. Restore vapor barrier and finish according to insulation Specifications for this Project.

- F. Check air flow within intake plenums and mixing boxes of air handling units for uneven flow and temperature stratification and prepare a report with profile elevations (temperature and velocity) on each coil or filter face for Architect.
- G. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- H. Verify that motor starters are equipped with properly sized thermal protection.
- I. Check dampers for proper position to achieve desired airflow path.
- J. Check for airflow blockages.
- K. Check condensate drains for proper connections and functioning.
- L. Check for proper sealing of air-handling unit components.
- M. Check for proper sealing of air duct system.

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 - 1. Measure fan static pressures to determine actual static pressure as follows:
 - a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
 - b. Measure static pressure directly at the fan outlet.
 - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.
 - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
 - 2. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
 - a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.
 - 3. Measure static pressures entering and leaving other devices such as sound traps, heat recovery equipment, and air washers, under final balanced conditions.
 - 4. Select required sheave sizes and advise installing contractor to change drive sheaves accordingly. Refer to Division 23 Section "Common Work Results for HVAC" for additional requirements.
 - 5. When existing air handling systems require rebalancing, select required sheave sizes and advise Mechanical Contractor to change drive sheaves accordingly. Refer to Division 23 Section "Common Work Results for HVAC" for additional requirements.
 - 6. Do not recommend fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure

amperage in full cooling, full heating, economizer, and any other operating modes to determine the maximum required brake horsepower.

- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
 - 1. Measure airflow at a point downstream from the balancing damper and adjust volume dampers until the proper airflow is achieved.
 - a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
 - 2. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
- C. Measure terminal outlets and inlets without making adjustments.
 - 1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
- D. Adjust terminal outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using volume dampers rather than extractors and the dampers at air terminals.
 - 1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
 - 2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.6 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

- A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a maximum set-point airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced airflow terminal units so they are distributed evenly among the branch ducts.
- B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
 - 1. Set outside-air dampers at minimum, and return- and exhaust-air dampers at a position that simulates full-cooling load.
 - 2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
 - 3. Measure total system airflow. Adjust to within indicated airflow.
 - 4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.
 - 5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow.

- a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.
6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets as described for constant-volume air systems.
7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
8. Record the final fan performance data.

3.7 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare test reports with pertinent design data and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against approved pump flow rate.
- B. Prepare schematic diagrams of systems' "as-built" piping layouts, or use reduced scale contract documents with notations.
- C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
 1. Open all manual valves for maximum flow.
 2. Check expansion tank liquid level.
 3. Check makeup-water-station pressure gage for adequate pressure for highest vent.
 4. Check flow-control valves for specified sequence of operation and set at indicated flow.
 5. Set system controls so automatic valves are wide open to heat exchangers.
 6. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
 7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.

3.8 PROCEDURES FOR HYDRONIC SYSTEMS

- A. Measure water flow at pumps. Use the following procedures, except for positive-displacement pumps:
 1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
 2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
 3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
 4. Report flow rates that are not within plus or minus 5 percent of design.
- B. Set calibrated balancing valves, if installed, at calculated presettings.

- C. Measure flow at all stations and adjust, where necessary, to obtain first balance.
 - 1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.
- D. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.
- E. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:
 - 1. Determine the balancing station with the highest percentage over indicated flow.
 - 2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
 - 3. Record settings and mark balancing devices.
- F. Equipment installed with pressure independent characterized control valves (PICCV) or auto-flow devices shall not require hydronic system balancing unless multiple coils are served from a single PICCV or auto-flow device (Example: AHU coil banks with multiple coils). Measure flow through each PICCV and auto-flow device and compare measured value to scheduled value to verify proper valve/device was installed and valve is functional. Verify flow for 100 percent of PICCV and auto-flow devices. Report discrepancies.
- G. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.
- H. Measure the differential-pressure control valve settings existing at the conclusions of balancing, and record in report.

3.9 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

- A. Balance variable-flow hydronic systems by following the "Proportional Balancing Procedure" in accordance with NEBB.
- B. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

3.10 PROCEDURES FOR PRIMARY-SECONDARY-FLOW HYDRONIC SYSTEMS

- A. Balance the primary system crossover flow first, then balance the secondary system.

3.11 PROCEDURES FOR HEAT EXCHANGERS

- A. Measure water flow through all circuits.
- B. Adjust water flow to within specified tolerances.
- C. Measure inlet and outlet water temperatures.
- D. Record inlet steam pressure.

- E. Record settings of safety and relief valves.

3.12 PROCEDURES FOR MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
 - 1. Manufacturer, model, and serial numbers.
 - 2. Motor horsepower rating.
 - 3. Motor rpm.
 - 4. Efficiency rating.
 - 5. Power factor.
 - 6. Nameplate and measured voltage, each phase.
 - 7. Nameplate and measured amperage, each phase.
 - 8. Starter size.
 - 9. Starter thermal-protection-element rating.
 - 10. Fuse number and size.
- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass for the controller to prove proper operation. Record observations, including controller manufacturer, model and serial numbers, and nameplate data.

3.13 PROCEDURES FOR CHILLERS

- A. Balance water flow through each evaporator and condenser to within specified tolerances of indicated flow with all pumps operating. With only one chiller operating in a multiple chiller installation, do not exceed the flow for the maximum tube velocity recommended by the chiller manufacturer. Measure and record the following data with each chiller operating at design conditions:
 - 1. Evaporator-water entering and leaving temperatures, pressure drop, and water flow.
 - 2. If water-cooled chillers, condenser-water entering and leaving temperatures, pressure drop, and water flow.
 - 3. Evaporator and condenser refrigerant temperatures and pressures.
 - 4. Power factor if factory-installed instrumentation is furnished for measuring kilowatt.
 - 5. Kilowatt input if factory-installed instrumentation is furnished for measuring kilowatt.
 - 6. Capacity: Calculate in tons of cooling.
 - 7. If air-cooled chillers, verify condenser-fan rotation and record fan and motor data including number of fans and entering- and leaving-air temperatures.

3.14 PROCEDURES FOR CONDENSING UNITS

- A. Verify proper rotation of fans.
- B. Measure entering- and leaving-air temperatures.
- C. Record compressor data.

3.15 PROCEDURES FOR HEAT-TRANSFER COILS

- A. Water Coils: Measure the following data for each coil:
 - 1. Entering- and leaving-water temperature.
 - 2. Water flow rate.
 - 3. Water pressure drop.
 - 4. Dry-bulb temperature of entering and leaving air.
 - 5. Wet-bulb temperature of entering and leaving air for cooling coils.
 - 6. Airflow.
 - 7. Air pressure drop.

- B. Refrigerant Coils: Measure the following data for each coil:
 - 1. Dry-bulb temperature of entering and leaving air.
 - 2. Wet-bulb temperature of entering and leaving air.
 - 3. Airflow.
 - 4. Air pressure drop.
 - 5. Refrigerant suction pressure and temperature.

3.16 PROCEDURES FOR TEMPERATURE MEASUREMENTS

- A. During TAB, report the need for adjustment in temperature regulation within the automatic temperature-control system.

- B. Measure indoor wet- and dry-bulb temperatures every other hour for a period of two successive eight-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.

- C. Measure outside-air, wet- and dry-bulb temperatures.

3.17 TOLERANCES

- A. Set HVAC system airflow and water flow rates within the following tolerances:
 - 1. Air handling equipment and outlets: Plus or minus 5 percent.
 - a. Where terminal units serve 6 or more outlets within a common room, individual outlets may vary up to plus or minus 10 percent of design flow rates if overall room supply is within plus or minus 5 percent.
 - 2. Heating-Water Flow Rate: 0 to minus 10 percent.
 - 3. Cooling-Water Flow Rate: 0 to plus 5 percent.

3.18 REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

- B. Status Reports: As Work progresses, prepare reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.19 FINAL REPORT

- A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.
- B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
 - 1. Include a list of instruments used for procedures, along with proof of calibration.
- C. Final Report Contents: In addition to certified field report data, include the following:
 - 1. Pump curves.
 - 2. Fan curves.
 - 3. Manufacturers' test data.
 - 4. Field test reports prepared by system and equipment installers.
 - 5. Other information relative to equipment performance, but do not include Shop Drawings and Product Data.
- D. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:
 - 1. Title page.
 - 2. Name and address of TAB firm.
 - 3. Project name.
 - 4. Project location.
 - 5. Architect's name and address.
 - 6. Engineer's name and address.
 - 7. Contractor's name and address.
 - 8. Report date.
 - 9. Signature of TAB firm who certifies the report.
 - 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 - 11. Summary of contents including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 - 12. Nomenclature sheets for each item of equipment.
 - 13. Notes to explain why certain final data in the body of reports varies from indicated values.
 - 14. Test conditions for fans and pump performance forms including the following:
 - a. Settings for outside-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Face and bypass damper settings at coils.

- e. Fan drive settings including settings and percentage of maximum pitch diameter.
 - f. Inlet vane settings for variable-air-volume systems.
 - g. Settings for supply-air, static-pressure controller.
 - h. Other system operating conditions that affect performance.

- E. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
 - 1. Quantities of outside, supply, return, and exhaust airflows.
 - 2. Water flow rates.
 - 3. Terminal units.
 - 4. Balancing stations.

- F. Air-Handling Unit Test Reports: For air-handling units with coils, include the following:
 - 1. Unit Data: Include the following:
 - a. Unit identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Unit arrangement and class.
 - g. Discharge arrangement.
 - h. Sheave make, size in inches, and bore.
 - i. Sheave dimensions, center-to-center, and amount of adjustments in inches.
 - j. Number of belts, make, and size.
 - k. Number of filters, type, and size.

 - 2. Motor Data:
 - a. Make and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Sheave dimensions, center-to-center, and amount of adjustments in inches.
 - g. Power factor efficiency.

 - 3. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm.
 - b. Total system static pressure in inches wg.
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg.
 - e. Filter static-pressure differential in inches wg.
 - f. Preheat coil static-pressure differential in inches wg.
 - g. Cooling coil static-pressure differential in inches wg.
 - h. Heating coil static-pressure differential in inches wg.
 - i. Outside airflow in cfm.
 - j. Return airflow in cfm.
 - k. Outside-air damper position.
 - l. Return-air damper position.
 - m. Vortex damper position.

G. Apparatus-Coil Test Reports:

1. Coil Data:

- a. System identification.
- b. Location.
- c. Coil type.
- d. Number of rows.
- e. Fin spacing in fins per inch o.c.
- f. Make and model number.
- g. Face area in sq. ft.
- h. Tube size in NPS.
- i. Tube and fin materials.
- j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):

- a. Airflow rate in cfm.
- b. Average face velocity in fpm.
- c. Air pressure drop in inches wg.
- d. Outside-air, wet- and dry-bulb temperatures in deg F.
- e. Return-air, wet- and dry-bulb temperatures in deg F.
- f. Entering-air, wet- and dry-bulb temperatures in deg F.
- g. Leaving-air, wet- and dry-bulb temperatures in deg F.
- h. Water flow rate in gpm.
- i. Water pressure differential in feet of head or psig.
- j. Entering-water temperature in deg F.
- k. Leaving-water temperature in deg F.

H. Gas- and Oil-Fired Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:

1. Unit Data:

- a. System identification.
- b. Location.
- c. Make and type.
- d. Model number and unit size.
- e. Manufacturer's serial number.
- f. Fuel type in input data.
- g. Output capacity in Btuh.
- h. Ignition type.
- i. Burner-control types.
- j. Motor horsepower and rpm.
- k. Motor volts, phase, and hertz.
- l. Motor full-load amperage and service factor.
- m. Sheave make, size in inches, and bore.
- n. Sheave dimensions, center-to-center, and amount of adjustments in inches.

2. Test Data (Indicated and Actual Values):

- a. Total airflow rate in cfm.
- b. Entering-air temperature in deg F.
- c. Leaving-air temperature in deg F.
- d. Air temperature differential in deg F.
- e. Entering-air static pressure in inches wg.
- f. Leaving-air static pressure in inches wg.

- g. Air static-pressure differential in inches wg.
 - h. Low-fire fuel input in Btuh.
 - i. High-fire fuel input in Btuh.
 - j. Manifold pressure in psig.
 - k. High-temperature-limit setting in deg F.
 - l. Operating set point in Btuh.
 - m. Motor voltage at each connection.
 - n. Motor amperage for each phase.
 - o. Heating value of fuel in Btuh.
- I. Fan Test Reports: For supply, return, and exhaust fans, include the following:
- 1. Fan Data:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and size.
 - e. Manufacturer's serial number.
 - f. Arrangement and class.
 - g. Sheave make, size in inches, and bore.
 - h. Sheave dimensions, center-to-center, and amount of adjustments in inches.
 - 2. Motor Data:
 - a. Make and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Sheave dimensions, center-to-center, and amount of adjustments in inches.
 - g. Number of belts, make, and size.
 - 3. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm.
 - b. Total system static pressure in inches wg.
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg.
 - e. Suction static pressure in inches wg.
- J. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
- 1. Report Data:
 - a. System and air-handling unit number.
 - b. Location and zone.
 - c. Traverse air temperature in deg F.
 - d. Duct static pressure in inches wg.
 - e. Duct size in inches.
 - f. Duct area in sq. ft.
 - g. Indicated airflow rate in cfm.
 - h. Indicated velocity in fpm.
 - i. Actual airflow rate in cfm.
 - j. Actual average velocity in fpm.

k. Barometric pressure in psig.

K. Air-Terminal-Device Reports:

1. Unit Data:

- a. System and air-handling unit identification.
- b. Location and zone.
- c. Test apparatus used.
- d. Area served.
- e. Air-terminal-device make.
- f. Air-terminal-device number from system diagram.
- g. Air-terminal-device type and model number.
- h. Air-terminal-device size.
- i. Air-terminal-device effective area in sq. ft.

2. Test Data (Indicated and Actual Values):

- a. Airflow rate in cfm.
- b. Air velocity in fpm.
- c. Preliminary airflow rate as needed in cfm.
- d. Preliminary velocity as needed in fpm.
- e. Final airflow rate in cfm.
- f. Final velocity in fpm.
- g. Space temperature in deg F.

L. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:

1. Unit Data:

- a. System and air-handling unit identification.
- b. Location and zone.
- c. Room or riser served.
- d. Coil make and size.
- e. Flowmeter type.

2. Test Data (Indicated and Actual Values):

- a. Airflow rate in cfm.
- b. Entering-water temperature in deg F.
- c. Leaving-water temperature in deg F.
- d. Water pressure drop in feet of head or psig.
- e. Entering-air temperature in deg F.
- f. Leaving-air temperature in deg F.

M. Packaged Chiller Reports:

1. Unit Data:

- a. Unit identification.
- b. Make and model number.
- c. Manufacturer's serial number.
- d. Refrigerant type and capacity in gal.
- e. Starter type and size.
- f. Starter thermal protection size.
- g. Compressor make and model number.
- h. Compressor manufacturer's serial number.

2. Water-Cooled Condenser Test Data (Indicated and Actual Values):
 - a. Entering-water temperature in deg F.
 - b. Leaving-water temperature in deg F.
 - c. Entering-water pressure in feet of head or psig.
 - d. Water pressure differential in feet of head or psig.
 3. Air-Cooled Condenser Test Data (Indicated and Actual Values):
 - a. Entering- and leaving-air temperature in deg F.
 4. Evaporator Test Reports (Indicated and Actual Values):
 - a. Entering-water temperature in deg F.
 - b. Leaving-water temperature in deg F.
 - c. Entering-water pressure in feet of head or psig.
 - d. Water pressure differential in feet of head or psig.
 5. Compressor Test Data (Indicated and Actual Values):
 - a. Voltage at each connection.
 - b. Amperage for each phase.
 - c. Kilowatt input.
 - d. Crankcase heater kilowatt.
 - e. Chilled-water control set point in deg F.
 - f. Condenser-water control set point in deg F.
 6. Refrigerant Test Data (Indicated and Actual Values):
 - a. Oil level.
 - b. Refrigerant level.
- N. Compressor and Condenser Reports: For refrigerant side of unitary systems, stand-alone refrigerant compressors, air-cooled condensing units, or water-cooled condensing units, include the following:
1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Unit make and model number.
 - d. Compressor make.
 - e. Compressor model and serial numbers.
 2. Test Data (Indicated and Actual Values):
 - a. Inlet-duct static pressure in inches wg.
 - b. Outlet-duct static pressure in inches wg.
 - c. Entering-air, dry-bulb temperature in deg F.
 - d. Leaving-air, dry-bulb temperature in deg F.
 - e. Condenser entering-water temperature in deg F.
 - f. Condenser leaving-water temperature in deg F.
 - g. Condenser-water temperature differential in deg F.
 - h. Condenser entering-water pressure in feet of head or psig.
 - i. Condenser leaving-water pressure in feet of head or psig.
 - j. Condenser-water pressure differential in feet of head or psig.
 - k. Control settings.
 - l. Voltage at each connection.

- m. Amperage for each phase.
 - n. Kilowatt input.
 - o. Crankcase heater kilowatt.
 - p. Number of fans.
 - q. Condenser fan rpm.
 - r. Condenser fan airflow rate in cfm.
 - s. Condenser fan motor make, frame size, rpm, and horsepower.
 - t. Condenser fan motor voltage at each connection.
 - u. Condenser fan motor amperage for each phase.
- O. Heat-Exchanger/Converter Test Reports: For steam and hot-water heat exchangers, include the following:
- 1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Service.
 - d. Make and type.
 - e. Model and serial numbers.
 - f. Ratings.
 - 2. Primary Water Test Data (Indicated and Actual Values):
 - a. Entering-water temperature in deg F.
 - b. Leaving-water temperature in deg F.
 - c. Entering-water pressure in feet of head or psig.
 - d. Water pressure differential in feet of head or psig.
 - e. Water flow rate in gpm.
 - 3. Secondary Water Test Data (Indicated and Actual Values):
 - a. Entering-water temperature in deg F.
 - b. Leaving-water temperature in deg F.
 - c. Entering-water pressure in feet of head or psig.
 - d. Water pressure differential in feet of head or psig.
 - e. Water flow rate in gpm.
- P. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:
- 1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Service.
 - d. Make and size.
 - e. Model and serial numbers.
 - f. Water flow rate in gpm.
 - g. Water pressure differential in feet of head or psig.
 - h. Required net positive suction head in feet of head or psig.
 - i. Pump rpm.
 - j. Impeller diameter in inches.
 - k. Motor make and frame size.
 - l. Motor horsepower and rpm.
 - m. Voltage at each connection.
 - n. Amperage for each phase.
 - o. Full-load amperage and service factor.

- p. Seal type.
- 2. Test Data (Indicated and Actual Values):
 - a. Static head in feet of head or psig.
 - b. Pump shutoff pressure in feet of head or psig.
 - c. Actual impeller size in inches.
 - d. Full-open flow rate in gpm.
 - e. Full-open pressure in feet of head or psig.
 - f. Final discharge pressure in feet of head or psig.
 - g. Final suction pressure in feet of head or psig.
 - h. Final total pressure in feet of head or psig.
 - i. Final water flow rate in gpm.
 - j. Voltage at each connection.
 - k. Amperage for each phase.

3.20 INSPECTIONS

A. Initial Inspection:

- 1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the Final Report.
- 2. Randomly check the following for each system:
 - a. Measure airflow of at least 10 percent of air outlets.
 - b. Measure water flow of at least 5 percent of terminals.
 - c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
 - d. Measure sound levels at two locations.
 - e. Measure space pressure of at least 10 percent of locations.
 - f. Verify that balancing devices are marked with final balance position.
 - g. Note deviations to the Contract Documents in the Final Report.

B. Final Inspection:

- 1. After initial inspection is complete and evidence by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Architect.
- 2. TAB firm test and balance engineer shall conduct the inspection in the presence of Architect.
- 3. Architect shall randomly select measurements documented in the final report to be rechecked. The rechecking shall be limited to either 10 percent of the total measurements recorded, or the extent of measurements that can be accomplished in a normal 8-hour business day.
- 4. If the rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
- 5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
- 6. TAB firm shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes and resubmit the final report.

7. Request a second final inspection. If the second final inspection also fails, Owner shall contract the services of another TAB firm to complete the testing and balancing in accordance with the Contract Documents and deduct the cost of the services from the final payment.

3.21 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional testing, inspecting, and adjusting during near-peak summer and winter conditions.

END OF SECTION 230593

SECTION 230933 - TEMPERATURE CONTROLS

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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 work of this section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."
 - 3. Division 23 Section "Testing, Adjusting, and Balancing."
 - 4. Division 26 Section "Electrical General Requirements."
 - 5. Division 26 Section "Control-voltage Electrical Power Cables."
 - 6. Division 26 Section "Hangers and Supports for Electrical Systems."
 - 7. Division 26 Section "Raceways and Boxes."

1.2 SUMMARY

- A. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.

1.3 DEFINITIONS

- A. BACnet: Communications open protocol for building automation system networks and control (developed by ASHRAE and documented per ANSI/ASHRAE Standard 135-2012).
- B. BAS: Building Automation System
- C. CAD: Computer Aided Design.
- D. DDC: Direct-digital controls.
- E. LonWorks (aka LonTalk): Communications open protocol as developed by Echelon Corporation that is utilized with building automation system networks and control.
- F. TC: Temperature Control.

1.4 SYSTEM DESCRIPTION

- A. Temperature control building automation system consisting of direct digital control system controllers, sensors, transducers, relays, switches, data communication network, etc. and all associated control wiring and raceway systems.
- B. BAS/DDC system programming, database generation. Graphic display generation accessible through Building Network Supervisory Controller or at the remote operator workstation (when applicable for project).
- C. Electric thermostats, control valves, dampers, operators, control wiring, etc.
- D. Gauges, indicating devices, electric and electronic control accessories, and other control system devices.

1.5 SEQUENCE OF OPERATION

- A. Control sequences for HVAC systems, subsystems, and equipment are indicated on project drawings.

1.6 SUBMITTALS

- A. Submit under Division 20 and 23 provisions of respective project and as supplemented in this section.
- B. All control submittal requirements shall be submitted at one time with exception to control valves, automated dampers, and initial phases of work associated with fast-track projects (when required). Early submittals of control valves and automated dampers shall be incorporated with the complete temperature controls submittal.
- C. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.
 - 1. Each control device labeled with setting or adjustable range of control
- D. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
- E. Shop Drawings:
 - 1. Shop drawings shall be done on CAD. Minimum size 11" x 17".
 - 2. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
 - 3. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
 - 4. Details of control enclosure including panel faces and interior, including controls, instruments, terminations blocks and component labeling.
 - 5. Written sequence of operation for each controlled system.
 - 6. Schedule of dampers including size, leakage, and flow characteristics (Refer to Design Data).
 - 7. Schedule of valves including leakage and flow characteristics (Refer to Design Data).

8. Complete bill of materials to identify and quantify all control components.
 9. Overall system schematic showing communication trunk cabling from Building Network Supervisory Controller(s) to BAS field level controllers including component locations and wire termination details.
 10. DDC controller layouts showing connected data points and LAN connections. DDC controller terminations including power supply and remote control component termination details shall be provided.
 11. Point list for each DDC controller including point descriptions and addresses. This information may be incorporated with DDC controller layouts.
 12. List of system graphics to be provided with proposed tree diagram of graphics organization. Items to include: Each system, floor plan.
- F. Graphic Displays: One month after TC Shop Drawing submittal, TC Contractor shall submit graphical display backgrounds for preliminary Engineer review. Concept for each floor plan, each system, each terminal unit template. Engineer understands that final representation of graphics may not be available until BAS database is established during course of construction. Thorough graphics review will be conducted by Engineer as part of the TC/BAS acceptance procedure.
- G. Design Data: Provide indicated component selection and sizing criteria for the following component categories:
1. Control valves:
 - a. Component tag.
 - b. Equipment served/function.
 - c. Media type.
 - d. Design flow rate (GPM or lbs./hr).
 - e. Design pressure drop (ft. head) or (psi), where applicable.
 - f. Calculated valve Cv, where applicable.
 - g. Selected valve Cv, where applicable.
 - h. Resultant pressure drop (ft. head) or (psi) with selected valve.
 - i. Valve size.
 - j. Line size to valve connection (excluding reducers).
 - k. Type (ball, butterfly, globe, etc.).
 - l. Configuration (2-way, 3-way mixing, 3-way diverting).
 - m. Normal position (normally open, normally closed, floating).
 - n. Actuator spring range (where applicable).
 - o. Actuator power requirement.
 - p. Valve shut-off rating (ft. head) or (psi)
 - q. Valve body pressure/temperature rating.
 - r. Valve manufacturer/model number.
 - s. Actuator manufacturer/model number.
 2. Dampers:
 - a. Component tag.
 - b. Equipment served/function.
 - c. Overall damper size (inch width x inch height).
 - d. Quantity of damper sections with respective size(s):
 - e. Material and gauge of thickness.
 - f. Mounting orientation (horizontal or vertical).
 - g. Blade configuration (parallel or opposed)
 - h. Pressure drop (in. WG).
 - i. Shut-off rating/differential pressure rating (in. wg).
 - j. Leakage rating (CFM/sq. ft. at 4 in. wg).
 - k. Normal position (normally open, normally closed, floating).
 - l. Actuator spring range (where applicable).
 - m. Actuator power requirement.

- n. Actuator torque requirement.
 - o. Actuator quantity.
 - p. Damper manufacturer/model number.
 - q. Actuator manufacturer/model number.
3. Flow measuring probes - Air:
- a. Component tag.
 - b. Equipment served/function.
 - c. Duct dimension (inch width x inch height) if applicable.
 - d. Fan inlet diameter (inch) if applicable)
 - e. Probe quantity.
 - f. Probe length (inch).
 - g. Flow rate (CFM).
 - h. Flow velocity (FPM).
 - i. Probe manufacturer/model number.
 - j. Transmitter manufacturer/model number.
4. Flow measuring probes - Water:
- a. Component tag.
 - b. Equipment served/function.
 - c. Pipe size/inside diameter (inch)
 - d. Probe length.
 - e. Flow rate (GPM).
 - f. Flow velocity (FPS).
 - g. Probe manufacturer/model number.
 - h. Transmitter manufacturer/model number.
5. Flow measuring stations - Air:
- a. Component tag.
 - b. Equipment served/function.
 - c. Duct dimension (inch width x inch height).
 - d. Station dimension (inch width x inch height).
 - e. Flow rate (CFM).
 - f. Flow velocity (FPM).
 - g. Pressure drop (in. wg).
 - h. Station manufacturer/model number.
 - i. Transmitter manufacturer/model number.
6. Gauges:
- a. Component tag.
 - b. Equipment served/function.
 - c. Units/range of scale
- H. Wall mounted temperature sensor, thermostat and/or other temperature control device cover color shall be coordinated to match color of wall mounted electrical device components and cover plates - coordinate with electrical contractor. Provide samples of available temperature control device cover colors to Architect upon request or if available temperature control device colors do not match electrical device colors so a desired color selection may be determined. Provide sample of temperature sensor / thermostat guard upon request of Architect, Engineer or Owner.
- I. Qualification Data: For firms and persons specified in "Quality Assurance" Article.

- J. Submit field reports indicating operating conditions after detailed check out of systems at Date of Substantial Completion.
- K. Project Record Documents: Include the following:
 - 1. Revise Shop Drawings to reflect actual installation and operating sequences.
 - 2. Record actual locations of control components, including control units, thermostats, and sensors.
 - 3. Submit the electronic files for all as-built shop drawings in pdf format on USB Flash Drives (3 Total).
- L. Software and Firmware Operational Documentation: Include the following:
 - 1. DDC controller keypad operating instructions and DDC controller override features, where applicable.
 - 2. Device address list.
 - 3. Program Software Backup: On a magnetic media or compact disc, complete with data files.
 - 4. Software license required by and installed for DDC workstations and control systems.
 - 5. DDC workstation software operating instructions for scheduling equipment, trending data, displaying graphics, commanding points, adding/deleting/modifying points, changing setpoints, and setting up alarms.
 - 6. Advanced DDC workstation operating instructions for graphics generation, control sequence programming and program modification.
 - 7. Printout of software applications and graphic screens.
- M. Maintenance Manuals: Include the following:
 - 1. Product data with installation details, maintenance instructions and lists of spare parts for each type of control device.
 - 2. Keypad illustrations and step-by-step procedures indexed for each operator function, where applicable.
 - 3. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
 - 4. Calibration records and list of set points.

1.7 REFERENCES

- A. AMCA 500 - Test Methods for Louvers, Dampers and Shutters.
- B. ANSI/ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure fittings.
- C. ANSI/ASTM B32 - Solder Metal.
- D. ANSI/NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- E. ASTM B280 - Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
- F. ASTM B75 - Seamless Copper Tube for General Engineering Purposes.
- G. ASTM D1693 - Environmental Stress - Cracking of Ethylene Plastics.
- H. ASTM E1 - Specification for ASTM Thermometers.

- I. MMC – Michigan Mechanical Code, version applicable for project.
- J. NEMA DC 3 - Low-Voltage Room Thermostats.
- K. UL 1820 - Fire Test of Pneumatic Tubing for Flame and Smoke Characteristics Only.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is an approved installer of the automatic control system manufacturer for both installation and maintenance of units required for this Project.
- B. Manufacturer Qualifications: A firm experienced in manufacturing automatic temperature-control systems similar to those indicated for this Project and with a record of successful in-service performance.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with all applicable code requirements for project.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Factory-Mounted Components: Where control devices specified in this Section are indicated or optional to be factory mounted on equipment, arrange for shipping of control devices to unit manufacturer.

1.10 COORDINATION

- A. Coordinate work under Division 20 and 23 provisions and as supplemented in this section.
- B. Coordinate location of space temperature sensors, space humidity sensor, thermostats, humidistats, and other exposed control sensors with plans and room details before installation.
- C. Coordinate installation of system components with installation of mechanical systems and equipment to achieve compatibility.
- D. Ensure installation of components is complementary to installation of similar components in other systems.
- E. Coordinate control wiring requirements, including actual terminal block numbers, with mechanical equipment manufacturers or suppliers.
- F. Coordinate work with the Laboratory Controls Contractor to provide air supply requirements, control valves where indicated and integration of lab controls to the BAS when indicated.
- G. Coordinate equipment with Division 28 Section "Fire Alarm" to achieve compatibility with equipment that interfaces with that system.

- H. Ensure control system installation is complete, checked, tested and functioning properly prior to system balancing and Owner/Engineer system checkout.
- I. Cooperate fully with the Test and Balance Contractor and provide labor to operate the temperature control system as required to meet the scope of work defined in Division 23 Section "Testing, Adjusting and Balancing."

1.11 WARRANTY

- A. Provide warranty per Division 20 Section "Mechanical General Requirements" and as supplemented in this section.
- B. Provide 24 hour per day emergency service during warranty period, with maximum response period of four (4) hours. Provide phone number(s) for quick assistance by a Service Engineer regarding hardware or software problems.
- C. Provide scheduled maintenance service during warranty period to inspect, calibrate, and adjust controls. Make a minimum of one eight-hour service call every three months. Notify Owner prior to each scheduled inspection trip. Submit written reports upon completion of service.
- D. Provide any software or firmware revisions which are released by the DDC system manufacturer during the warranty period, at no additional cost to the Owner.

1.12 POSTED OPERATING INSTRUCTIONS

- A. Provide DDC controller related as-built documents in protective binder or clear plastic display envelope for each control enclosure panel. These instructions shall include such items as as-built control diagrams and sequence of operation, simplified narrative instructions and materials necessary to aid in the operation of the equipment at the local control panels.

1.13 SPECIAL TOOLS

- A. Deliver two sets of any special tools required for operation, adjustment, resetting or maintenance, excluding PC laptop.

1.14 PROTECTION OF PROPRIETARY INFORMATION

- A. Non-disclosure agreement(s) that may be subject to proprietary manuals and software shall be submitted by the proprietary equipment manufacturer to the Owner for approval and signature during the warranty period.

PART 2 - PRODUCTS

2.1 DESCRIPTION OF THE BUILDING AUTOMATION SYSTEM (BAS)

- A. The building automation system (BAS) shall be fully integrated, distributed data processing system incorporating direct digital control (DDC) for the control and monitoring of heating, ventilating and air conditioning (HVAC) equipment and other related systems. Microprocessor based BAS field level DDC controllers shall be directly

connected to HVAC equipment sensors and actuators. A data communication network shall allow data exchange between the BAS field level DDC controllers and the Building Network Supervisory Controller. The Building Network Supervisory Controller shall be the primary operator BAS interface point for the building either through web-browser direct or through server application software (when applicable) or through local or remote Operator Workstation (when applicable to project).

B. Approved Manufacturer – System / Approved Installer (Locations) as listed:

1. Johnson Controls – Facility Explorer with FX Controllers / by:
 - a. ControlNet (Swartz Creek, Kalamazoo & Grand Rapids, MI).
 - b. Johnson Controls, Inc. (Auburn Hills, MI) – NOT Metasys Products.
 - c. Metro Controls, Inc. (Clinton Twp, MI).
 - d. Commercial Controls, Inc. (Saginaw, MI).

2.2 BAS BUILDING NETWORK SUPERVISORY CONTROLLER (TRIDIUM N4 PLATFORM)

A. The Building Network Supervisory Controller, utilizing the HTML5 platform, shall provide the interface between the Owner’s Ethernet and the field control devices, and provide global supervisory control functions over the control devices connected to the NAC. It shall be capable of executing application control programs to provide:

1. Calendar functions
2. Scheduling.
3. Trending.
4. Alarm monitoring and routing.
5. Time synchronization.
6. Integration of BACnet controller data.
7. Network Management functions for all BACnet based devices.

B. The Network Area Controller shall provide the following hardware and driver features as a minimum:

1. One RS-232 port
2. One RS-485 port with BACnet MS/TP Driver.
3. Battery Backup
4. Flash memory for long term data backup (If battery backup or flash memory is not supplied, the controller must contain a hard disk with at least 1 gigabyte storage capacity).
5. Where the option for expanded memory is available, it must be supplied.

C. Provide LonWorks or MODBUS driver(s) as required for system or equipment integration requirements for project.

D. The network supervisory controller shall be sized appropriately per building to handle the required quantity of connected controllers and devices.

E. Provide 5 year service agreement per network supervisory controller for updating firmware/software as available by manufacturer. Labor for updating the controllers shall be included.

F. For Tridium based systems, provide Niagara 4 JACE-8000 series network supervisory controllers.

G. Manufacturer:

1. Manufacturers as listed for Building Automation System (based on N4 JACE-8000 platform).
2. Vykon N4 JACE-8000 series is to be used in lieu of listed manufacturer's standard product per requirements of Owner's existing network or as indicated on the construction drawings.

2.3 BAS BUILDING NETWORK SUPERVISORY CONTROLLER (PROPRIETARY PLATFORMS)

- A. The Building Network Supervisory Controller shall provide the interface between the Owner's Ethernet and the field control devices, and provide global supervisory control functions over the control devices connected to the NAC.
- B. The network supervisory controller shall be sized appropriately per building to handle the required quantity of connected controllers and devices.
- C. Manufacturers: As listed for Building Automation System.

2.4 DIRECT DIGITAL CONTROL (DDC) FIELD LEVEL CONTROLLERS

- A. Modular in design and consisting of stand-alone microprocessor board with ROM and fully custom programmable RAM, EPROM, and/or EEPROM memory, integral interface equipment and power surge protection. DDC controllers shall be connected directly to sensors, controlled devices and the communication network.
- B. Powerfail Restart and Battery Backup: Minimum of 72 battery backup hours for complete system RAM memory and clock, with automatic battery charger or 48 hour low voltage alarm warning. Upon full system power recovery, all clocks shall be automatically synchronized, and all controlled equipment shall be automatically restarted based on correct clock time and sequence of operation.
- C. Provide fully functional communication interface ports for communication between processor, other processors, portable programmer's terminal, portable operator's unit or the remote Operator Workstation when applicable for project.
- D. Panel enclosure for controller, associated power supply and other ancillary control components shall be finished steel or rigid plastic with hinged door and keyed lock. Electronics shall be removable for protection during mounting of panel.

2.5 DDC CONTROLLER LOCAL DISPLAY AND KEYPAD

- A. Provide a display and keypad built-in to the face of DDC controller enclosure panel located in major mechanical rooms.
- B. The local display and keypad shall allow the operator to read point values and/or point status, adjust setpoints and/or parameters, and display point and alarm information.
- C. The display shall have a minimum 24 character capability. Keypad operation shall be menu driven.
- D. Use of the local display and keypad shall not interfere with normal data communication network operation or with the normal operation of the connected DDC controller.

2.6 DDC CONTROLLER SOFTWARE

- A. Operating system shall work in real time, provide prioritized task scheduling, control time programs, monitor DDC controller communications, scan inputs and outputs, and contain built-in diagnostics.
- B. Input/output point processing shall include the following:
 - 1. Continuous update of input and output values and/or conditions. All connected points are to be updated at least once per second.
 - 2. Assignment of proper engineering units and status condition identifiers to all points.
 - 3. In addition to physical or "hardware" points required, "software" points shall be provided where required for command access and meaningful displays, where required by the "execution" portion of this section or where required on the DDC input/output points lists. "Software" points shall appear identical to physical points in output displays and shall be assignable to text descriptors, logical groups, reports, etc. in the same manner as physical points. "Software" points shall be assigned alarm limits in the same manner as physical points.
- C. Command control software shall manage the receipt of commands from control panels, portable programmer's terminal, portable operator's unit or the remote Operator Workstation when applicable for project.
 - 1. Command delay, programmable from 0 to 2 minutes, shall be provided to prevent simultaneous energizing of large loads. Command delays shall be honored throughout the BAS DDC network, not just within the DDC controller. Delays shall be assignable on an individual per point basis.
 - 2. Each command shall be assigned a command and residual priority to manage contentions created by multiple programs having access to the same command point. Only commands with a higher command priority than the existing residual priority shall be permitted to execute. Whenever a command is allowed to execute, its assigned residual priority shall replace the existing residual priority.
 - 3. A "fixed mode" option shall be supported to allow inputs to, and outputs from DDC control programs to be set to a fixed state or value. When in the "fixed mode," inputs and outputs shall be so noted in all reports.
 - 4. A "last user" record is to be maintained to positively identify which program or manual command is in control of a given point. The last user information shall be displayed and printed along with other point data of logical groups.
- D. Provide self-test procedure. Notify remote Operator Workstation (when applicable for project) for maintenance, performance, software, cable break, or data transmission problems. Identify variables as reliable or unreliable. Variables identified as unreliable shall use default in calculation.
- E. Alarm Processing
 - 1. High/Low Alarm: Analog input alarm comparison with the ability to assign two individual sets of high and low limits (warning and actual alarm) to an input. Each alarm shall be assigned a unique differential to prevent a point from oscillating into and out of alarm. Alarm comparisons are to be made each scan cycle.
 - 2. Floating Alarm: Where analog controlled values are automatically varied by software (such as hot water temperature reset), a single set of alarm limits shall be provided for those varying values. These alarm limits shall then "float" a user definable differential above and below the varying setpoint value.
 - 3. Abnormal Alarm: When a digital input is not in agreement with the commanded state of its associated output point, or when a digital input is not in its normal state, an abnormal alarm shall be generated. Abnormal "on" shall cause an alarm,

as well as abnormal "off." Alarm time delay for digital inputs to prevent nuisance alarms shall be provided. Each digital input alarm time delay shall be adjustable from zero to two minutes in one-second increments.

4. Alarm lockout shall be provided to positively lock out alarms when equipment is turned off or when a true alarm is dependent on the condition of an associated point. Lockout points and lockout initiators shall be operator programmable. On initial startup of air handler and other mechanical equipment, a "timed lockout" period shall be assigned to analog points to allow them to reach a stable condition before activating alarm comparison logic. Timed lockout period shall be programmable on a per point basis from 0 to 90 minutes in one-minute increments.
5. The capability of automatically initiating commands upon the occurrence of an alarm.

F. Totalization

1. Run time shall be accumulated based on the status of digital input points. It shall be possible to totalize either on time or off time up to 10,000 hours with one-minute resolution. Run time counts shall be resident in memory and have DDC controller resident run time limits assignable through portable programmer's terminal, portable operator's unit or the remote Operator Workstation when applicable for project.
2. A transition counter shall be provided to accumulate the number of times a device has been cycled on or off. Counter shall be capable of accumulating 600,000 switching cycles. Limits shall be assignable to counts to provide maintenance alarm printouts.
3. Analog totalization capability shall be provided to allow the totalization of electricity, air, water and steam flow, etc. These flows shall be totalized with respect to time and converted to the appropriate energy unit. It shall be possible to automatically set time intervals for totalization, adjustable from one second to 365 days. The totalization program shall keep track of the maximum and minimum instantaneous analog value measured during the period, including the date and time at which each occurred.

G. DDC Controller Programming / Configuration

1. All DDC controllers shall be fully programmable or configurable per required controller application type. DDC controllers which require remote or factory programming or configuration are not acceptable. DDC controllers with custom programs which may not be modified by the user are not acceptable. "Custom" programming shall mean allowing the alteration of actual control logic, and shall not be limited to allowing only the alteration of setpoints, gains, parameters, time constants, etc.
2. DDC controllers shall be provided to meet the control strategies as called for in the sequences of operation on the drawings. If a configurable application specific DDC controller cannot meet this requirement, a DDC fully programmable controller shall be provided.
3. All DDC controller setpoints, gains, parameters, time constants, etc., associated with DDC controller programs shall be available to the operator for display and modification via portable programmer's terminal, portable operator's unit or the remote Operator Workstation when applicable for project.
4. Each DDC controller shall have resident in its memory and available to the programs a full library of DDC algorithms, intrinsic control operators, and arithmetic, logic and relational operators for implementation of control sequences. Functions to be provided shall include, but not be limited to, the following:
 - a. Mathematical: Absolute value, calculate, square root, power, sign, average, totalize.

- b. Logic: OR, AND, compare, negate.
 - c. Fixed Formula: High and low select, span, rate, ramp, enthalpy, wet bulb, dew point, relative humidity, humidity ratio, and filter.
 - d. Data Manipulation: Store, file and set.
 - e. Control Routines: Real-time based functions, proportional control, proportional-integral control, proportional-integral-derivative control, adaptive control (self-tuning), direct-acting, reverse acting, feedforward, fixed setpoint, calculated setpoint, adjustable setpoint, lead lag, hysteresis correction, event initiation/ software interlock.
- H. Building Automation System program applications (as required for controllers)
- 1. Time of day scheduling: Allow the creation and maintenance of operating schedules for selected points based on time of day and holiday scheduling. At least two independent start and stop times per day for each system shall be allowed. Each point shall be allowed to have a unique time program, or points shall be able to be grouped and assigned to a common time program. Both digital and analog output points shall be able to be assigned to a time program. This software shall work in conjunction with the time of day scheduler software at the remote Operator Workstation (when applicable for project). This program shall also work in conjunction with the optimum start and optimum stop application software.
 - 2. Optimum Start: Start equipment based on outdoor temperature, space temperature, and system response to minimize energy usage and to assure that comfort conditions are reached exactly at scheduled occupancy time (occupancy schedules are defined under "Time Of Day Scheduling"). This program shall operate in both the heating and cooling cycles. An adaptive algorithm shall be employed which automatically adjusts the start time according to previous performance and shall automatically assign longer lead times for weekend and holiday shutdowns.
 - 3. Enthalpy Optimization: Using standard psychrometric calculations, automatically determine which air source, outdoor air or return air, presents the least total heat load, and automatically adjust mixed air damper position. When outside enthalpy exceeds return air enthalpy, the outside air damper shall go to its minimum position. Typically, the outside air damper must be in its minimum position before the cooling coil valve is allowed to open.
 - 4. Duty Cycle: Periodically cycle electrical equipment to reduce energy consumption and/or energy demand. Each load shall be assigned a cycle interval and an off period. A load leveling algorithm shall be utilized to assure that cycle periods do not coincide.
 - 5. Demand Limiting: Distributed power demand program shall be based on a sliding window instantaneous demand algorithm. The DDC controller(s) connected to the demand meter shall calculate the demand, forecast the demand trend, compare it to established demand limits, and initiate load shedding action or reestablishment of loads as required. Shedding shall be on a sequential basis with least important loads shed first and restored last. Restoration cycle shall add the most important loads first. DDC controllers on the network shall each have a four-tier shed table for assignment of sheddable loads. When a request is issued to the network to shed a specific number of kilowatts, each DDC controller shall shed Tier 1 loads, Tier 2 loads, etc. until the shed requirement is met. The program shall have the capability to sum the readings from multiple meters connected to multiple DDC controllers on the network, and to shed various loads from multiple DDC controllers on the network.
 - 6. Warm-Up: Position the outside air dampers in an adjustable (minimum) position, and trigger a digital output(s) normally used to signal air terminal units to move to their maximum flow settings. When the desired space temperature is reached, as determined by feedback from space temperature sensor(s), the digital output shall return the air terminal units to their normal operation. When occupancy

time is reached, the outside air dampers shall be controlled by the normal occupied mode control sequence. During the warm-up cycle, the outside air damper shall be set at the position which minimizes outside air intake while preventing over/under pressurizing of ductwork. This program shall work in conjunction with the time scheduling program and/or the optimum start program as required.

7. Night Cycle: Cycle HVAC equipment on and off as required to maintain an operator selectable unoccupied space temperature. During the equipment "on" time, the outside air damper shall be maintained in an adjustable position which minimizes outside air intake while preventing over/under pressurization of ductwork. The equipment shall be cycled such that energy reduction during unoccupied periods is uniform.
8. Night Purge: Night Purge program shall apply to cooling cycle only. Night Purge shall introduce 100% outdoor air any time the outdoor air is above 50 degrees F, the space temperature is above 75 degrees F, the outdoor air temperature is below space temperature and the outdoor air dew point is less than 60 deg F. Purging shall stop when outdoor air is below 50 deg F, or space temperature is below 75 deg F, or outdoor temperature is less than 5 deg F cooler than space temperature, or outdoor air dew point is greater than 60 deg F.
9. Reset Optimization: Adjust equipment discharge setpoints based on one of the following criteria:
 - a. By sensing the worst case requirements (e.g., the zone requiring the most heating or cooling and providing only the minimum energy required to meet the load.
 - b. Adjusting the setpoint in direct proportion to another sensed variable (e.g., reset supply water temperature based on outside temperature).

2.7 DDC AIR TERMINAL UNIT CONTROLLERS

- A. Microprocessor based controllers capable of stand-alone operation for control of pressure independent air terminal units. Controllers shall be networked together and connected to the building's BAS/DDC network.
- B. Controllers shall have separate adjustable minimum and maximum airflow setpoints. Controllers shall work in conjunction with the air handling unit's DDC panel to provide the sequence of operation as indicated on the drawings. Setpoints shall be adjustable through the portable programmer terminal.
- C. Provide electronic type air terminal unit damper operators compatible with the controller and the air terminal units provided.
- D. Each controller shall have an internal differential pressure transducer capable of utilizing the total and static pressure signals from the air terminal unit's velocity sensor. Velocity sensor shall be furnished by air terminal unit manufacturer.
- E. Each controller shall have electronic outputs compatible with the electronically operated air terminal unit tempering coil control valve and perimeter radiation control valve where applicable
- F. TC contractor shall provide 24 VAC power requirements including transformers.
- G. If coordinated with mechanical contractor. Controllers and damper operators shall be furnished to the air terminal unit manufacturer for factory mounting by the air terminal unit manufacturer; otherwise, controls shall be field installed.
- H. Room temperature sensors for the DDC air terminal unit controllers:

1. Sensing Element: Thermistor or resistance temperature detector (RTD) type. Accuracy shall be +/- 0.5 degrees F over the range of 55 degrees F to 95 degrees F, including calibration error, repeatability, hysteresis, and yearly drift.
2. Cover: with tamper-proof fasteners.
3. Provide with exposed setpoint adjustment dial and exposed temperature reading.
4. Provide with exposed override switch to allow an occupant to reset the space to occupied control during the unoccupied cycle for a predetermined time period.
5. Provide with portable operator unit plug-in port.

2.8 DDC INPUT/OUTPUT SENSORS

A. Air Static/Differential Pressure Transmitters:

1. Variable capacitance type with ranges not exceeding 150 percent of maximum expected input. Transmitter shall have zero and span adjustments.
2. Safe overpressure rating shall be minimum 5 times the range.
3. Temperature compensated with thermal error of not greater than 0.04 percent of full scale in temperature range of 40 to 100 deg F.
4. Accuracy: +/- 0.5% of full scale including calibration error, repeatability, hysteresis, and yearly drift.
5. Manufacturers:
 - a. Air Monitor.
 - b. Belimo.
 - c. Dwyer.
 - d. Modus
 - e. Setra.

B. Carbon Dioxide Sensors:

1. Carbon dioxide sensing cell shall consist of a nondispersive infrared carbon dioxide gas cell that uses a pulsed source and has no free air optical path. Output shall be linearized 4-20 mA with the 24 VDC input. In addition, the unit shall be capable of providing SPDT switching of an external low voltage circuit at an adjustable setpoint. The unit shall be specifically designed for the wall or duct application specified. Return air aspiration boxes shall be designed by and approved by the manufacturer. Unit shall have single point setpoint and span adjustment. The unit shall have no moving parts.
2. Power for the sensor shall be extended from a transformer or adaptor installed adjacent to the DDC controller enclosure panel, and shall be run parallel to the 4-20 mA signal cable.
3. Minimum sensing range shall be 0-2,000ppm.
4. Overall Accuracy shall be 3% of full scale including calibration error, repeatability, hysteresis and yearly drift.
5. Minimum calibration interval shall be 5 years.
6. Contractor shall provide all necessary equipment and test gas for calibration and shall calibrate all CO₂ sensors in accordance with the manufacturer's recommendations.
7. Manufacturer:
 - a. Specified BAS product where available that meets the requirements herein.
 - b. Belimo.
 - c. TelAire.
 - d. Vaisala.

e. Veris.

C. Current Sensors:

1. Split-core or donut type transformer for monitoring AC current, with analog output signal as indicated. Current sensors used on motor side of variable frequency drives shall have low frequency detection capability.
2. Analog sensors shall have accuracy of 31% full scale.
3. Manufacturers:
 - a. ACI.
 - b. Johnson Controls.
 - c. Senva.
 - d. Veris Industries.

D. Current Switches:

1. Split-core or donut type transformer for monitoring AC current, with digital output signal. Current switches used on motor side of variable frequency drives shall have low frequency detection capability.
2. For Electronically Commutated Motor (ECM) applications: Current switch shall be rated for ECM operation with amperage trip setting higher than trickle/idle/standby amperage with ECM off and amperage trip setting lower than minimum speed setting. Verify minimum amperage expectation for equipment with equipment suppliers to select appropriate current switch from list of approved manufacturers as their minimum trip settings vary from 0.15A to 0.5A.
3. For induction motor applications (as applicable): Current switch shall have adjustable trip setting to accommodate VFC minimum speed settings, to detect fan belt loss, or to detect pump coupling detachment. Set trip setting at approximately 90% of normal motor operating amperage.
4. Manufacturers:
 - a. ACI.
 - b. Johnson Controls.
 - c. Senva.
 - d. Veris Industries.

E. Differential Pressure Transmitters (Commercial Version):

1. Transmitters used for measuring differential pressure only:
 - a. Each differential pressure transmitter shall be selected and calibrated for operations between 0 and 200% of the normal differential pressure. The calibration point shall be rounded upward to the nearest 10 inches of water column (for spans less than 200" W.C.) or to the nearest 5 psi for larger spans. Calibration date shall be included on an embossed tag attached to each transmitter.
 - b. The accuracy, including linearity, hysteresis and repeatability, of the transmitter for measuring differential pressure shall be better than 2% of the span stated above throughout a 4:1 turndown.
 - c. The transmitter shall not be damaged by pressures of up to 500 psig on either side of the transmitter and all wetted parts shall be essentially inert in the presence of up to a 40% concentration of ethylene or propylene glycol in water.
 - d. Provide a drain valve for each side of the pressure chamber. Furnish and install mounting brackets appropriate for the installation location.
 - e. Span and zero shall be individually adjustable.

- f. With LCD Display.
- g. Manufacturers:
 - 1) Belimo.
 - 2) Dwyer.
 - 3) Setra.
 - 4) Veris Industries.

F. Differential Pressure Transmitters (Industrial Version):

1. Transmitters used for measuring flow rates:

- a. Each differential pressure transmitter shall be selected and calibrated for operations between 0 and 125% of the normal differential pressure and up to 150 psig line pressure. The calibration point shall be rounded upward to the nearest 10 inches of water column (for spans less than 200" W.C.) or to the nearest 5 psi for larger spans. Calibration date shall be included on an embossed tag attached to each transmitter.
- b. The accuracy, including linearity, hysteresis and repeatability, of the transmitter for measuring differential pressure shall be better than 0.25% of the span stated above throughout a 6:1 turndown.
- c. The transmitter shall not be damaged by pressures of up to 1000 psig on either side of the transmitter and all wetted parts shall be essentially inert in the presence of up to a 40% concentration of ethylene glycol in water.
- d. Provide a drain valve for each side of the pressure chamber. Furnish and install mounting brackets appropriate for the installation location.
- e. Span and zero shall be individually adjustable.
- f. Manufacturers:
 - 1) Tobar.
 - 2) ITT Barton.
 - 3) Yokogawa.
 - 4) Taylor.
 - 5) Rosemount.
 - 6) Honeywell Industrial Division.
 - 7) Foxboro.
 - 8) SOR.

2. Transmitters used for measuring differential pressure only:

- a. Each differential pressure transmitter shall be selected and calibrated for operations between 0 and 200% of the normal differential pressure. The calibration point shall be rounded upward to the nearest 10 inches W.C. (for spans less than 200" W.C.) or to the nearest 5 psi for larger spans. Calibration date shall be included on an embossed tag attached to each transmitter.
- b. The accuracy, including linearity, hysteresis and repeatability, of the transmitter for measuring differential pressure shall be better than 2% of the span stated above throughout a 4:1 turndown.
- c. The transmitter shall not be damaged by pressures of up to 500 psig on either side of the transmitter and all wetted parts shall be essentially inert in the presence of up to a 40% concentration of ethylene or propylene glycol in water.
- d. Provide a drain valve for each side of the pressure chamber. Furnish and install mounting brackets appropriate for the installation location.
- e. Span and zero shall be individually adjustable.
- f. Manufacturers:

- 1) Tobar.
- 2) ITT Barton.
- 3) Yokogawa.
- 4) Taylor.
- 5) Rosemount.
- 6) Honeywell Industrial Division.
- 7) Foxboro.
- 8) SOR.

3. Indication Gauges for Differential Pressure Transmitters:

- a. Each transmitter shall come with an indicating gauge which reads in gpm or inches of water (whichever is the final value desired). The gauge may be either an analog differential pressure gauge piped in parallel to the transmitter or a digital display wired directly to the output of the transmitter.
- b. The analog pressure gauge shall be selected and calibrated for the same span as the transmitter it serves.
- c. The accuracy, including linearity, hysteresis and repeatability, of the gauge for measuring differential pressure shall be better than 3% of the span stated above throughout its span. Calibration data shall be included on an embossed tag attached to each gauge.
- d. The gauge shall not be damaged by pressures of up to 500 psig on either side of the gauge and all wetted parts shall be essentially inert in the presence of up to 40% concentration of ethylene or propylene glycol in water.
- e. Scale shall be a minimum of 4.5" long. Furnish and install two bleed fittings for each gauge and mounting brackets appropriate for the installation location.

4. Three Valve Manifold:

- a. Provide a three-valve manifold for each transmitter. The manifold shall not be damaged by pressures of up to 500 psig and all wetted parts shall be essentially inert in the presence of up to a 40% concentration of ethylene glycol in water.
- b. The manifold shall be designed for direct mounting on the transmitter it serves and utilize quarter-turn valves to provide zeroing, blocking and normal service modes.

G. Humidity Sensors:

1. Elements: Thin film or polymer capacitive type or bulk polymer resistance type with linear output, accurate within 3 2% RH throughout the range of 10-95% RH and drift to be less than +/-0.25%.
2. Humidity sensors shall be resistant to chlorine and other cleaning agents.
3. Room Sensors: With locking cover matching space temperature sensors used.
4. Duct Sensors: With duct probe and mounting plate.
5. Manufacturers:
 - a. Specified BAS product where available that meets the requirements herein.
 - b. Belimo.
 - c. GE Industrial, Sensing (formerly General Eastern)
 - d. Rotronic.
 - e. Vaisala.
 - f. Veris - HD/HO Series.

H. Outside Air Flow (low velocity) Differential Pressure Transmitters:

1. The transmitters shall be capable of receiving signals of static, velocity and reference pressures, amplifying and scaling the resulting differential pressure signal to produce a 4-20 mA output signal linear to differential pressure. The transmitters shall have manual zeroing capability.
2. The differential pressure transmitters shall not be affected by over-pressurization up to 1 psig, and shall be furnished with a factory calibrated span and automatic zeroing circuit. The transmitters shall be housed in an enclosure with integral terminal box and with power and output signal conduit connection ports and separate access plate.
3. Calibrated span: shall not exceed 150 percent of maximum expected input.
4. Reference Accuracy: $\pm 0.50\%$ of span.
5. Hysteresis and dead band (combined): Less than 0.2% of span.
6. Repeatability: 0.15% of span.
7. Linearity: $\pm 0.25\%$ of span.
8. Include LCD Display.
9. Manufacturers:
 - a. Air Monitor-Veltron DPT 2500 Plus.
 - b. Custom Electronics Systems.

I. Outside Air Temperature/Humidity Combination Transmitters:

1. Dual transmitters housed in a single hinged enclosure with integral probes configured for exterior wall mount application with PVC sun shield. Unit shall provide separate 4-20 mA signals for temperature and humidity measurement.
2. Temperature sensor: Refer to Temperature Sensors specifications. Range of operation shall be -25 degrees F to 125 degrees F.
3. Humidity sensor: Refer to Humidity Sensors specifications. Range of operation shall be 0-100% RH.
4. Manufacturer:
 - a. Belimo.
 - b. Vaisala.
 - c. Veris.

J. Temperature Sensors:

1. Resistance temperature detectors (RTD) with 1000 ohm, thin-filmed platinum, nickel or balco element having 0.000385 temperature coefficient meeting the input requirements of the DDC controller.
2. Thermally sensitive resistors (thermistor) shall be 10k-type, epoxy or glass coated, having NTC characteristic, meeting the input requirements of the DDC controller.
3. Initial calibration accuracy shall be ± 0.5 deg F over the entire range. Range shall be as indicated below, or as appropriate to the application.
4. Additional error such as repeatability, stability, tolerance, linearity and hysteresis shall not exceed an additional ± 0.5 deg F additive (using RMS method) throughout the selected operating range for the application.
5. Temperature sensors shall be resistant to chlorine and other cleaning agents
6. Single point duct mounted sensors shall have 18" rigid probe and calibrated span of 20 - 120°F.
7. Averaging duct mounted sensors shall have 25' long averaging element and calibrated span of 20 - 120°F.
8. Liquid immersion sensors shall have welded stainless steel thermowells for ferrous pipe and brass thermowells for copper pipe. Length of sensor and thermowell shall be selected based on the diameter of the pipe to provide

- accurate, reliable and homogeneous sensing of the liquid temperature. Thermowell pressure rating shall meet or exceed the system minimum pressure rating. Sensors for chilled water application shall have calibrated span of 20 - 120°F. Sensors for hot water applications shall have calibrated span of 40 - 240°F
9. Room sensors shall have locking cover and a minimum span of 40 - 90°F.
 10. Outside air temperature (only) sensors shall have watertight inlet fitting and shall be shielded from direct rays of sun and wind.
 11. Manufacturers:
 - a. Specified BAS product where available that meets the requirements herein.
 - b. ACI - except PT1000 averaging sensor.
 - c. BAPI - Basys Series.
 - d. Belimo.
 - e. MAMAC
 - f. Minco.
 - g. TCS.
- K. Humidity, Temperature & Dew Point Sensor / Transmitters (HVAC High Performance Grade):
1. High performance Humidity, Temperature & Dew Point measurement with accuracy of +/- 0.8 % RH. Sensor range 0-160°F, 0-100%RH.
 2. Removable probe for calibration purposes. Provide 1 extra probe for every 4 sensor/transmitter units required for project.
 3. With two configurable and scalable outputs: 0-1V, 0-5V, 0-10V, 4-20mA for humidity, temperature and/or dew point readings.
 4. Wall or duct mounted as indicated.
 5. Provide display option where indicated.
 6. Transmitter power supply options for 24VDC, 24VAC as required.
 7. Provide weather shield for outdoor sensor installations.
 8. Provide guards for indoor installations as indicated on drawings.
 9. Provide product software (where applicable) for transmitter configuration and probe calibration.
 10. Manufacturers:
 - a. Rotronic, HygroFlex5 transmitter with HC2-S probe and HW4 product software.
 - b. Approved Equal.
- L. Dew Point Sensor / Transmitters (Lab & Industrial High Performance Grade):
1. High performance chilled mirror technology with accuracy of +/- 1°F. Sensor range 0-160°F.
 2. Wall or duct mounted as indicated.
 3. Transmitter power supply options for 24VDC, 24VAC, 115VAC as required.
 4. Provide weather shield for outdoor sensor installations.
 5. Provide guards for indoor installations as indicated on drawings.
 6. Manufacturers:
 - a. Omega RHCM Series.
 - b. Approved Equal.

2.9 DDC DATA COMMUNICATIONS NETWORK

- A. Data communication network shall be provided to allow data exchange between the BAS field level DDC controllers and the Building Network Supervisory Controller.
- B. The BAS/DDC system-wide communication network shall consist of a primary peer-to-peer network, and at the Contractor's option, secondary sub-networks linked to the primary network. The primary network shall support peer-to-peer communications between primary network BAS field level DDC controllers. The Building Network Supervisory Controller shall be connected to the primary network. Secondary sub-networks when used shall interface with the primary network through the primary network BAS field level DDC controllers. At least one DDC controller connected to the primary peer-to-peer network shall be provided in each mechanical room, or as indicated on the drawings.
- C. Data communications media shall be twisted pair wires.
- D. The communications network shall allow shared point and control information between BAS field level DDC controllers. All required repeaters, hubs, active links, gateways, etc. and associated power supplies shall be provided as required to provide shared point and control information between BAS field level DDC controllers.
- E. Failure of any individual BAS field level DDC controller shall not cause the loss of communications between peer BAS field level DDC controllers.
- F. All data transmitted must be positively acknowledged as received or negatively acknowledged as not received. Negative acknowledgments shall cause a retransmission of the data. Network connected devices must send a "functioning" message each network cycle. Lack of a "functioning" message after successive retries shall constitute a device failure and shall be recognized as such by the network.
- G. Error recovery and communication initialization routines shall be resident in each network connected device.

2.10 DDC OPERATOR WORKSTATION SOFTWARE

- A. Operating System.
 - 1. Real time based system which shall provide true multi-tasking capability. Multi-tasking shall allow the user to perform concurrent execution of multiple real time tasks.
 - 2. It shall not be acceptable for background applications to be suspended while foreground applications are executed.
- B. Database Manager.
 - 1. Database manager shall manage all data on an integrated and non-redundant basis. It shall allow additions and deletions to the data base without any detriment to the existing data. Cross linkages shall be provided such that no data required by a software program may be deleted by the operator until that data has been deleted from its respective program.
 - 2. Menus shall clearly guide the operator through the database editing process. Database editing shall not interfere with any other Operator Workstation function.
 - 3. All database and/or program changes made at the Operator Workstation shall automatically be transferred from the Operator Workstation to the DDC Panels. All database and/or program modifications made at the DDC panels shall

automatically be transferred to the Operator Workstation and stored on disk at the Operator Workstation.

4. Database Format:
 - a. Divide points of control or monitoring by system.
 - b. Identify points with unique, structured point identifier reflecting "specific area" or "specific system," and "specified point."

C. Operator Interface Software

1. General: Hierarchical linked dynamic graphical user interface for access and display of system data and for commanding and modifying equipment operation. The user interface shall utilize the mouse or keyboard to provide "heads up" operation with pull-down menus, dialogue boxes, zoom, coloration and animation to facilitate ease of operation of the system. Multiple levels of graphic penetration shall be provided with operator assignable hierarchy. Dynamic system data points shall be assignable to each penetration level. Descriptors for graphics, points, alarms, etc. shall be modified through the Operator Workstation (under password control).
2. Operator access and password protection:
 - a. Operator access into the system shall require a password. A minimum of twelve (12) operators shall be able to be assigned a unique password. All sign-on/sign-off activity shall be automatically archived on the operator's station disk for subsequent display or printout as desired. The operator's initials shall be displayed on all reports and alarm acknowledgments.
 - b. At least the following three levels of system access shall be assignable to each operator:
 - 1) Level 1: Monitoring only
 - 2) Level 2: Monitoring and Commanding
 - 3) Level 3: Monitoring/Commanding/Programming
3. Data to be displayed within a unique graphic shall be assignable regardless of physical hardware address, communication channel or point type. Graphics shall be on-line programmable and under password access control. Points shall be assignable to multiple graphics where necessary to facilitate operator understanding of system operation and where specified. Graphics shall also contain calculated or "software" points. Each physical point and each point assigned to a graphic shall be assigned an English descriptor for use in reports.
4. Data segregation shall be provided for control of specific data routed to a printer, another Operator Workstation, or other peripheral. Point classes shall be randomly selectable such as all HVAC points, HVAC points second floor, all space temperature points, command points, etc. Display and/or output of data to a printer or monitor shall occur where there is a match of peripheral segregation class assignment and the point segregations. Peripherals shall be assignable and all assignments are to be on-line programmable and under password control.
5. Operator shall be able to use the mouse to move in either direction through the graphic penetration hierarchy. In addition to being able to move one level in either direction through the hierarchy, the operator shall also be able to go directly to a specific level or access a specific point without following a fixed penetration path.
6. Points shall be displayed with dynamic data provided by the system with appropriate text descriptor, status or value, and engineering unit. Coloration shall be used to designate status and alarm states. Coloration shall be variable for each class of points, as chosen by the Owner. All point displays shall be dynamic, with update rates user adjustable on a per point basis from 20 seconds to 120 seconds.

7. For operators with the appropriate password, points shall be commandable directly from the Operator Workstation using the mouse or keyboard. Each binary output point shall be displayed with its current status (e.g., Open) and shall be operator commandable to go to the opposite position. Each analog output point shall be displayed with its actual incremental status (e.g., 20% Open, 80% Open, 100% Open, etc.) and shall be operator commandable to be move to any incremental position.
8. The operator shall be permitted to split or resize the viewing screen to show one graphic on the left half of the screen and another graphic, point report, etc., on the right half screen. This shall allow real time monitoring of one part of the system while displaying other parts of the system or data from the system.
9. An on-line "help" utility shall be provided to facilitate operator training and understanding. The "help" utility shall contain text and graphics to clarify system operation. At a minimum, help shall be available for every menu item and dialogue box.
10. Electronic messaging facility shall be provided on the Operator Workstation for any operator to enter a message to another operator. When an operator with a queued message signs onto the operator station, the display shall indicate that a message is waiting. Messages shall include the time and date the message was sent and the sender's name.
11. The operator shall be able to easily obtain a hard copy of any graphic and/or text display.

D. Alarm Handling Software

1. General: Alarm handling software shall be provided to respond to alarm conditions sensed and transmitted from the DDC panels. Alarms shall be handled on a first in/first out basis in accordance with alarm priority ranking. A minimum of 20 alarms must be capable of being stored in case of simultaneous multiple alarms. Alarm handler shall be active whether or not an operator is signed on at any given time to assure that all alarms are processed at all times.
2. Alarms shall be displayed at the Operator Workstation with the following minimum information given for each alarm: Type of alarm condition, analog value or status, point descriptor, and action-taking message. Action-taking message, for each alarm, shall indicate possible corrective action as a text string capable of being up to 280 characters in length.
3. Alarms shall be assignable to appropriate Operator Workstations, operators or printers. Only those operators having the appropriate password access level shall be allowed to acknowledge alarms.
4. An alarm summary feature shall be provided to allow the operator to display and/or print out all current alarms.
5. Each point shall be assigned to an alarm class. Each alarm class shall be uniquely assigned any of the following alarm processing attributes:
 - a. Alarm priority.
 - b. Audible alarm duration (none, 10 seconds, 20 seconds, continuous).
 - c. Audible alarm rate (slow-medium-fast).
 - d. Historically archived (yes or no).
 - e. Alarm printed, with printer ID.
 - f. Associated coloration.

E. Time of Day Scheduler

1. Time of day schedules shall be created and modified in a graphic display window. A complete week's schedule shall be displayed on a single screen, with individual inputs for each of the seven days, and with the capability of multiple start/stop times per day. Holiday and "special day" inputs shall allow alternate schedules on these user-defined days. A calendar shall be included to allow time of day scheduling one year in advance.

2. Each schedule shall be able to control up to 60 points.
3. Override capability for individual command points shall be provided. Overrides shall be capable of being entered up to one week in advance.
4. All schedules and override requests shall be automatically transferred to the DDC panels and executed by the DDC panels.
5. An editing function shall be provided to allow one day's schedule to be copied to the next day, or to allow one system's entire schedule to be copied to another system, etc.
6. The time of day scheduler shall work closely with the optimum start/stop programs resident in the DDC panels, as well as other application programs. For example, once the desired occupancy time is defined by the time of day scheduler, the optimum start program shall calculate the time at which the HVAC system must start to attain the desired space temperature at occupancy time.

F. Reports

1. Standard Reports: Standard reports shall be provided which shall be operator selectable to appear on the Operator Workstation, any selected printer or both. A "terminate report" command shall be available to allow the operator to stop any report in the process of being printed. The following standard preformatted reports shall be provided for operator selection:
 - a. Point summary reports shall be available at any penetration level (facility, building, area, system) and shall include only points at and below that level. Point summary reports shall include the current value/status and condition, and system and point descriptors for all points. Point summary reports shall be selectable for all points, only those points in alarm, fixed points, disabled points, locked out points, locked out and in alarm points, analog input or output points, digital input or output points. All reports shall be capable of being scheduled to run at a specific time and/or interval via an operator function supported by necessary data entry templates and/or interactive prompts.
 - b. Trend reports shall allow the operator to randomly select logical arrays of points to be recorded at selectable time intervals. It shall be possible to assign up to six variables to each trend report. The format, headers, footers, and calculations shall be selectable by the operator. The trend report shall be stored to disk and shall be capable of being subsequently displayed and/or printed by the operator.
 - c. Alarm and run time reports shall be automatically issued to assigned printers immediately upon occurrence, and shall consist of the point descriptor, the status or value of the point with engineering unit, the time and date, and an action taking alarm message.
 - d. The user shall be provided with a command trace feature selectable on a per point basis allowing the archiving of all commands issued to each point. The archived trace shall include the command, the command source, the point ID, and the time and date. Command trace reports shall be output upon operator demand.
2. Custom Reports: A custom report capability shall be provided to allow the user to format reports of any mix of text, points with status/value and descriptors, and points with status/value only. Custom reports shall be scheduled or requested manually. Microsoft Excel shall be provided and fully integrated with the BAS database, and available to the user.

G. Graphic Generation Software

1. An on-line graphic development facility to allow the operator to develop new graphic displays or modify existing graphic displays, and to assign and position any array of points within each graphic display.

2. All graphic displays shall be generated on-line through the graphic generation software package at the Operator Workstation. Graphic display generation shall not require taking the Operator Workstation off-line and shall not interfere with point archiving or alarms.
3. Graphics shall be created through use of the mouse and keyboard.
4. Basic drawing functions shall include, as a minimum, freehand, lines, boxes, circles, arcs, ellipses. Text shall have multiple fonts and sizes. All symbols shall be capable of being moved, rotated, flipped, and scaled in all directions. Crosshairs, dimensions and grids shall be available for developing accurately scaled drawings.
5. A standardized graphic library of HVAC and automation symbols shall be provided, and shall include fans, control valves, motors, chillers, standard ductwork diagrams, dampers, etc. In addition, the user shall have the capability to create custom symbols and store them in the graphic library.
6. The system shall provide expansion to a minimum of 500 graphic displays.

H. Custom DDC Programming Software

1. Text Programming Mode

- a. Full screen text editor for creating new custom programs or editing existing programs. Programs shall be for use within the DDC panels. Text editor shall provide standard word-processing functions such as adding, modifying or deleting letters, words or full lines, search and replace function, copying blocks of text, etc.
- b. The operator shall be capable of inserting comments at any point within the program code to explain the objectives of the program and to clarify the code.
- c. The operator shall be capable of archiving program segments for use in creating new custom control programs.
- d. A library of standard DDC control algorithms shall be provided as program code archived modules to aid the operator in developing new control programs. These archived modules shall contain embedded comments to allow the operator to understand the objective of the control algorithms as well as the function of each line of the program code. The following algorithms shall be provided in the library, as a minimum: Proportional (P) control, Proportional-Integral (PI) control, Proportional-Integral-Derivative (PID) control, Adaptive Control (Self Tuning), Sequence, Reversing, Ratio, Time Delay, Time of Day, Highest Select, Lowest Select, Analog Controlled Analog Output and Digitally Controlled Analog Output.

I. System Management Software

1. Complete utilities necessary for management of the network of DDC panels and devices.
2. Multiple dynamic graphic displays showing each DDC panel, Operator Workstation peripheral, and communication links. Clicking on any device shall start an interactive dialogue allowing the user to observe the device status and to select device management options. Each device shall also be provided with an English descriptor of up to 60 characters. Devices in a failed or non-responsive mode shall show up distinctly in the system graphic displays.
3. Provide software to execute and observe diagnostics of any remote device connected to the communication network and the ability to deactivate and restart the device.
4. The operator shall be provided with the ability to override the use of a portable operators unit on any remote DDC panel.

J. Third-Party Software Compatibility

1. The system must be capable of running standard, off-the-shelf, MS-DOS compatible software packages concurrently with the real time system.
2. The system shall include a windowing feature to allow the operator to monitor the real time system and use third party software simultaneously.

2.11 AIRFLOW MEASURING PROBES - DUCT MOUNTED

- A. Duct airflow measuring probes shall contain multiple total and static pressure sensors located along the exterior surface of the probe, designed to compensate for non-axial or turbulent flow.
- B. Thermal Dispersion type technology may be used in-lieu of static pressure measurement.
- C. Probes shall be constructed of extruded aluminum. Probes shall be provided with mounting plate, gasket, and static and total pressure fittings. Probe and mounting hardware shall facilitate easy removal and reinstallation of the probes.
- D. The number of sensors on each probe, and the quantity of probes provided at each location, shall comply with ASHRAE standards for duct traversing. Multiple probes provided at a single location shall be interconnected external to the duct to produce an average signal.
- E. For each airflow measurement location, the measured velocity pressure shall have accuracy within 3 2% of the full scale throughout the velocity range of 300-4000 fpm.
- F. Each airflow measurement location shall be provided with an air volume gauge, dial and pointer type with diaphragm element. Black letters on white background, 4" diameter, with scale calibrated to permit direct reading of the airflow (in cfm) of the connected airflow measuring station. LCD readout with associated transmitter is acceptable.
- G. Manufacturers:
 1. Air Monitor Corporation.
 2. Farr.
 3. Ultratech Industries, Inc.
 4. Brandt.
 5. Tek-Air Systems, Inc.
 6. Ramsey Ventures.
 7. Ebtron.

2.12 AIRFLOW MEASURING PROBES - FAN INLET

- A. Fan inlet airflow measuring probes shall contain multiple total and static pressure sensors located along the exterior surface of the probe, designed to compensate for non-axial or turbulent flow. Two probes shall be provided for each fan inlet opening.
- B. Thermal Dispersion type technology may be used in-lieu of static pressure measurement.
- C. Probes shall be constructed of extruded aluminum. Probes shall be provided with mounting bracket designed for attachment to fan inlet bell, and shall have static and total pressure fittings. Probe and mounting hardware shall facilitate easy removal and reinstallation of the probes.

- D. Fan inlet airflow measuring probes shall not induce a measurable pressure drop, nor shall the sound level within the system be amplified by its presence.
- E. For each fan, the measured airflow shall have accuracy within 3 3% of the actual flow throughout a fan operating range of 6 to 1 capacity turndown.
- F. Each airflow measurement location shall be provided with an air volume gauge, dial and pointer type with diaphragm element. Black letters on white background, 4" diameter, with scale calibrated to permit direct reading of the airflow (in cfm) of the connected airflow measuring station. LCD readout with associated transmitter is acceptable.
- G. Manufacturers:
 - 1. Air Monitor Corporation.
 - 2. Farr.
 - 3. Ultratech Industries, Inc.
 - 4. Brandt.
 - 5. Tek-Air Systems, Inc.
 - 6. Ramsey Ventures.
 - 7. Ebtron.

2.13 AIRFLOW MEASURING PROBES - OUTSIDE AIRFLOW

- A. Duct airflow measuring probes shall be Thermal Dispersion type.
- B. Probes shall be constructed of extruded aluminum. Probes shall be provided with mounting plate, and gasket. Probe and mounting hardware shall facilitate easy removal and reinstallation of the probes.
- C. The number of sensors on each probe, and the quantity of probes provided at each location, shall comply with ASHRAE standards for duct traversing. Multiple probes provided at a single location shall be interconnected external to the duct to produce an average signal.
- D. For each airflow measurement location, the measured velocity pressure shall have accuracy within 3 2% of the full scale throughout the velocity range of 0-4000 fpm.
- E. Associated transmitter at each airflow measurement location shall be provided with LCD readout to indicate airflow (in CFM) of the connected airflow measuring station.
- F. Manufacturers / Model:
 - 1. Ebtron / Gold Series.
 - 2. Air Monitor Corporation / ELECTRA-flo.

2.14 AIRFLOW MEASURING STATIONS - DUCT MTD THERMAL DISPERSION (INCLUDING OA FLOW)

- A. Airflow measuring station with thermal dispersion type technology utilizing perimeter chamber with array of inlet ports to produce an overall average airflow rate shall be a preassembled unit including casing with connecting flanges, fabricated to the duct size.

- B. Airflow measuring station shall have a galvanized steel casing (or stainless steel if manufacturer's standard) and the entire assembly shall be fabricated to withstand the maximum pressures and velocities for the application.
- C. Probe type units shall be constructed of extruded aluminum and the number of sensors on each probe, and the quantity of probes provided at each location, shall comply with ASHRAE standards for duct traversing. Multiple probes shall be interconnected external to the duct to produce an average signal.
- D. Perimeter chamber type units shall direct air through the mass airflow sensing probe.
- E. For each airflow measurement location, the measured airflow shall have accuracy within 3 2% of the full scale throughout the velocity range of 0-4000 fpm.
- F. Associated transmitter at each airflow measurement location shall be provided with LCD readout to indicate airflow (in CFM) of the overall airflow measuring station.
- G. Manufacturer:
 - 1. NJK Precision Air Flow Measurement Products.

2.15 AIRFLOW MEASURING STATIONS - DUCT MOUNTED PITOT TYPE (NOT FOR OA FLOW)

- A. Airflow measuring station shall contain multiple airflow traverse probes in a casing with connecting flanges, fabricated to the duct size.
- B. The multiple traverse probes shall be factory positioned and interconnected by metal tubing, with multiple total and static pressure sensors along the exterior surface of the probe. Total and static pressure shall be sensed at locations to comply with ASHRAE standards for duct traversing, and shall be interconnected to produce average signals.
- C. The airflow measuring stations shall be installed to meet at least the manufacturer's minimum installation recommendations for straight duct runs, and shall not amplify the sound levels within the duct. The maximum pressure drop shall be as scheduled, or 0.07" WG maximum.
- D. The measured velocity pressure shall have accuracy within 3 2% of the full scale throughout the velocity range of 300-4000 fpm.
- E. Airflow measuring station shall have a galvanized steel casing and the entire assembly shall be fabricated to withstand the maximum pressures and velocities for the application.
- F. Every airflow measuring station shall be furnished with an air volume gauge, dial and pointer type with diaphragm element. Black letters on white background, 4" diameter, with scale calibrated to permit direct reading of the airflow (in cfm) of the connected airflow measuring station.
- G. Manufacturers:
 - 1. Air Monitor Corporation.
 - 2. Farr.
 - 3. Brandt.
 - 4. Tek-Air Systems, Inc.

2.16 CONTROL AND INSTRUMENTATION TUBING

- A. Copper Tubing: ASTM B280 or ASTM B75, seamless, hard drawn or annealed.
 - 1. Fittings: ANSI/ASME B16.22, wrought copper.
 - 2. Joints: ANSI/ASTM B32, 95-5 tin antimony.
- B. Copper Tubing: ASTM B280 or ASTM B75, seamless, hard drawn or annealed.
 - 1. Fittings: UL approved rod or forged brass rated to 200 psig at 100 degrees F.
 - 2. Joints: Ball Sleeve compression type.
- C. Polyethylene Tubing: Black, UL 1820 flame and smoke retardant where exposed in an air plenum, virgin polyethylene, conforming to modified ASTM D1693 test. All non-metallic tubing shall be minimum 1/4" O.D.; micro-sleeve is not acceptable.
 - 1. Fittings: UL approved rod or forged brass rated to 200 psig at 100 degrees F.
 - 2. Joints: Compression or barbed type.

2.17 CONTROL VALVES AND VALVE OPERATORS

- A. Pressure dependent Characterized Ball Valves (2-way & 3-way):
 - 1. Up to 2 inches: Bronze body with screwed ends, stainless steel or chrome plated brass ball, characterizing disc, stainless steel or brass stem, and resilient reinforced Teflon seats.
 - 2. Manufacturers:
 - a. Belimo.
- B. Globe Valves (2-way & 3-way):
 - 1. Up to 2 inches: Bronze body, bronze trim, rising stem, renewable composition disc, single seated, screwed ends with backseating capability, repackable under pressure.
 - 2. Over 2 inches: Iron body, bronze trim, rising stem, plug-type disc, flanged ends, renewable seat and disc, repackable under pressure.
 - 3. Valve stem packing shall be tetrafluorethylene, spring loaded and self-adjusting. Packless construction is acceptable.
 - 4. Manufacturers:
 - a. Belimo.
- C. Butterfly Pattern: Refer to Division 20 Section "Valves" for valve body and trim requirements.
- D. Electric Operators:
 - 1. Operators shall be electronic type to accept signals from direct digital controller or modulating thermostat for proportional control.
 - 2. Valves shall spring return to normal position as indicated. Terminal unit tempering coil control valve operators are not required to be spring return.
 - 3. Select with sufficient shut-off power for system pressure and highest operating torque, and torque requirements of valves which may stick because of infrequent use.

4. Select to provide smooth proportioning control under operating conditions normal to the system.
5. Electric Butterfly Control Valve Actuators: Permanent split capacitor, reversible electric motor which drives a compound epicyclic gear, thermal overload protection, factory tested, factory lubricated, localized mechanical position indicator readable at 25 feet, 0-90 degree reversible operation, bolt directly to valve top plate. Housing shall be weatherproof and suitable for outdoor location. Provide thermostatically controlled heater for prevention of condensation at low temperatures, 120 VAC. Actuator ambient temperature range shall be -20 degrees F to +140 degrees F. Provide separate limit switches which close at the full open and full closed position, respectively. Actuator shall include a manually operated handwheel for manual override of the valve position.

E. Hydronic Systems:

1. Valve minimum pressure rating shall meet or exceed the system minimum pressure rating as noted for each system in Division 20 Section "Valves," and in Division 23 Section "Hydronic Piping."
2. Valve minimum temperature ratings shall be 250 deg F.
3. For globe valves: Replaceable plugs and seats of stainless steel or brass, selected for maximum lift under application conditions.
4. Two way and three way valves shall have equal percentage characteristics. Size two way valve operators to close valves against pump shut off head.
5. Pressure independent control valves shall be used for 2-way applications unless otherwise indicated. Select to achieve scheduled flow rate of the associated heat transfer device. If the scheduled flow rate is too high to achieve with one valve, provide multiple valves sized at flow divided equally of the scheduled flow rate and control all valves in unison - coordinate control valve quantity and the need for parallel piping of control valves with mechanical contractor.
6. Pressure Drop for pressure dependent characterized ball and globe valves: Select Control valves that result in a pressure drop at or as close as possible to scheduled information. If not scheduled, primary HVAC equipment and terminal equipment control valves shall be selected for a pressure drop close as possible to 11.5 feet of head (5 psig). TC Contractor shall use control valves that meet the pressure drop requirements from manufacturers listed above.

F. Natural Gas Solenoid Shutoff Valves:

1. Operation: Direct acting, electric solenoid operated, gas shutoff valve rated to be energized open when in service and closed (de-energized) when the EPO pushbutton is activated. Select valve solenoid coil electrical characteristics based on circuit power being provided. Valve shall be UL recognized component to Standard 429 - Electrically Operated Valves.
2. Description:
 - a. Action: Normally closed - energize to open.
 - b. Sizing: To close against the system pressure at "line-size."
 - c. Coordinate pipe connection style with the installation contractor.
 - d. Heavy-duty assembly.
 - e. Body: Brass for copper pipe and stainless steel for ferrous pipe.
 - f. Seats and Discs: NBR or PTFE.
 - g. Solenoid Enclosure: NEMA 250, Type 4.
3. Manufacturers:
 - a. ASCO 2/2 Series Model 200-series Modular.
 - b. Honeywell V4295 Series.

2.18 DAMPERS - AUTOMATED

- A. Performance: Test in accordance with AMCA 500.
- B. Frames: Galvanized steel, minimum 16 gauge, minimum 2 inches in width, welded or riveted with corner reinforcement for 12 gage structural equivalence.
- C. Blades: Galvanized steel, minimum 14 gauge, maximum blade size 8 inches wide, 60 inches long, attached to minimum 1/2 inch shafts. Dampers which are required to have a static pressure rating over 4 inch W.G. shall have minimum 3/4 inch solid shafts.
- D. Blade Seals: Synthetic elastomeric or Neoprene, mechanically attached, field replaceable.
- E. Jackshafts (where required): Minimum 1/2 inch galvanized steel.
- F. Jamb Seals: Stainless steel.
- G. Bearings: Oil impregnated sintered bronze or lubricant free, solid stainless steel. Provide thrust washers at bearings for all dampers which are to be mounted with blades in the vertical position.
- H. Linkages: Accessible for maintenance. Linkages may be located in airstream. Linkages located in damper frame shall be external to the duct, accessible for maintenance. Linkages located in the airstream shall be zinc-plated.
- I. Leakage: Less than 8 CFM per square foot based on 4 inches W.G. pressure differential.
- J. Static Pressure Rating: As scheduled on the drawings, or if not scheduled, minimum 4" W.G.
- K. Maximum Velocity: As scheduled on the drawings, or design for maximum velocity to be encountered in location where installed.
- L. Temperature Limits: -40 to 200 deg F.
- M. Dampers located in stainless steel or PVC coated ductwork (Refer to Division 23 Section "Metal Ducts" for ductwork requirements) and dampers located within stainless steel or corrosion-resistant coated environmental equipment (Refer to Division 23 Section "Environmental Equipment" for environmental equipment requirements): Fabricate and size as indicated above, with the following additional requirements:
 - 1. Frames: Type 316 stainless steel.
 - 2. Blades and shafts: Type 316 stainless steel.
 - 3. Blade seals: Type 316 stainless steel, mechanically attached.
 - 4. Jackshafts (where required): Minimum 3/4 inch stainless steel.
 - 5. Bearings: Solid stainless steel.
 - 6. Linkages: Accessible for maintenance. Linkages located in damper frames shall be external to the duct, accessible for maintenance. Linkages located in the airstream shall be Type 316 stainless steel.
 - 7. All components exposed to the airstream shall be constructed of Type 316 stainless steel:
- N. Manufacturers:
 - 1. American Warming & Ventilating.

2. Arrow United Industries.
3. Greenheck.
4. Honeywell.
5. Johnson Controls.
6. Louvers & Dampers, Inc.
7. Ruskin.
8. Tamco.
9. Vent Products.

2.19 DAMPERS, INSULATED OUTDOOR AIR / RELIEF AIR / EXHAUST AIR - AUTOMATED

- A. Performance: AMCA certified for Air Performance and Air Leakage.
- B. Frames: Extruded aluminum, .080-inch thickness minimum, 4 inches deep minimum, thermally broken, and insulated with polystyrene or polyurethane foam insulation.
- C. Blades: Extruded aluminum, internally insulated, and thermally broken. Maximum blade size 8 inches wide, 60 inches long.
- D. Shafts: Minimum 7/16 inch hexagonal or square corrosion resistant zinc plated steel.
- E. Blade Seals: Extruded EPDM, silicone, or synthetic elastomeric, mechanically attached.
- F. Jamb Seals: Silicone, or synthetic elastomeric, mechanically attached.
- G. Bearings: Dual bearing assembly of durable synthetic polymer resulting in no metal-to-metal contact. Provide thrust washers at bearings for all dampers which are to be mounted with blades in the vertical position.
- H. Linkage: Linkage shall be installed in the frame side and shall be constructed of aluminum and/or corrosion resistant zinc plated steel.
- I. Leakage: Less than 3 CFM per square foot at 1 inch W.G. pressure differential at minus 40 deg F.
- J. Static Pressure Rating: As scheduled on the drawings, or if not scheduled, minimum 4 inches W.G.
- K. Maximum Velocity: As scheduled on the drawings, or design for maximum velocity to be encountered in location where installed.
- L. Temperature Limits: Minus 40 to 155 deg F.
- M. Manufacturers:
 1. Greenheck ICD-45.
 2. Ruskin TED50 Series.
 3. Tamco Series 9000 BF.

2.20 DAMPER OPERATORS - ELECTRIC

- A. Electric damper motor shall be 24 or 120 volt two-position or modulating as required with spring return type and sized to operate the damper with sufficient reserve power for smooth operation from full close to full open and tight shut-off. Damper motor shall have "O ring" gaskets for weatherproof operation.

- B. Number: Sufficient to achieve unrestricted movement throughout damper range. Provide sufficient number of operators such that one operator does not operate more than the maximum square footage of damper area as recommended in standard catalog of manufacturer.
- C. Manufacturers:
 - 1. Belimo.

2.21 DIFFERENTIAL PRESSURE SWITCHES

- A. Shall provide electrical switching action upon a sensed pressure differential increase between two sensed points. Sensitivity shall be suitable for the application. Setpoint shall be adjustable over the full range of the device. Switching action shall open or close two independent single-pole, double-throw (SPDT) switches. Electrical switch rating shall be based on the application and circuit voltage
- B. Pressure rating of switch/connecting tubing and reset type:
 - 1. Filter pressure drop - Rated for 2 inches w.g. Provide automatic reset type.
 - 2. Duct static pressure - Rated for 10 inches w.g. Provide manual reset type when used for high limit cutout safety.

2.22 ELECTRICAL REQUIREMENTS FOR CONTROLS WORK

- A. Electrical accessories such as relays, switches, contactors and control transformers shall meet the requirements of the Division 26 Specifications of respective project.
- B. Electrical wiring and conduit shall meet the requirements of the Division 26 Specifications.
- C. All control wiring in mechanical rooms and any other exposed areas shall be run in conduit. Low voltage temperature control wiring in concealed accessible locations (i.e. above lay-in ceilings), as well as low voltage temperature control wiring within partitions, may be run using plenum rated cable, neatly tie-wrapped and fastened to the building structure (not to ceiling or ceiling support wires).
- D. Conduits carrying control wiring shall be sized for a maximum fill of 40% of capacity.
- E. Where raceway is required, two separate raceway systems shall be provided; one for A.C. wiring and the other for D.C. wiring.
- F. Data transmission cabling and equipment grounding procedures shall meet the latest FCC guidelines for electromagnetic field generation.
- G. All control wiring sizes and types shall meet or exceed the equipment manufacturer's recommendations.
- H. TC Contractor shall provide 24V power supply transformers for TC Contractor provided controllers. Maximum Transformer circuit for controls shall be 100VA serving controllers within mechanical room control panels or for remote terminal unit controllers served from common 24V power supply circuit. Transformers shall be located within enclosures provided by TC Contractor.

2.23 EMERGENCY POWER-OFF (EPO) PUSH-BUTTON

- A. ADA compliant, push-button switch with clear cover to prevent inadvertent closure. Push-to-activate push-button, and providing two SPDT contacts rated 10 Amps at 120 VAC.
- B. Manufacturers:
 - 1. Safety Technology International - model SS-2212PO
 - 2. Alarm Controls Corporation - model ADC-100.

2.24 FLOW METERS / REMOTE DISPLAY

- A. Inline Type: ONICON Model FT-3000 Series Inline Electromagnetic Flow Meter (For FM-x and FM-x indicated on the Temperature Control drawings). FT-3100 or FT-3200 for indicated accuracy applications. With following requirements:
 - 1. NIST traceable, wet calibrated flow-measuring element, transmitter, visual display, ANSI Class 150 or 300 mounting flanges, and calibration certificate.
 - 2. Application Range: This contractor shall be responsible for selecting the flowmeter options submitted based on the application. Flowmeter shall be constructed, calibrated and scaled for the intended application in terms of pipe size, pipe material, installation requirements, expected flow rate, ambient conditions and fluid characteristics which include but are not limited to pressure, temperature, conductivity and viscosity.
 - 3. Sensing Technology: Electromagnetic velocity-measuring element.
 - 4. Design: Electromagnetic sensing element shall utilize a minimum of two 316L stainless steel electrodes to measure the average flow rate velocity.
 - 5. Construction: Flowmeter shall consist of epoxy painted carbon steel outer body, 304 stainless steel flow tube and integral liner to be selected based on pipe size and operating temperature and fluid as follows:
 - a. Ebonite, 8-48" pipe size, Temperature Range of 32-175°F.
 - b. Polypropylene, 1-6" pipe size, Temperature Range of 32-140 °F.
 - c. PTFE, 1-6" pipe size, Temperature Range of 32-140 °F.
 - 6. Individual calibration tag shall be attached indicating calibration and programming information.
 - 7. Maximum Pressure Rating: 580 psig.
 - 8. Maximum Temperature Rating: 266°F.
 - 9. End Connections for NPS 1.0" and Larger: ANSI Class 150 Flange typical.
 - 10. Flow Range: Flow-measuring element and transmitter shall cover operating range of equipment or system served.
 - 11. FT-3200 For Decoupler applications with minimal upstream & downstream pipe diameters. Accuracy: Flowmeter shall provide calibrated outputs directly from the transmitter, throughout the operating range with the accuracy stated as follows:
 - a. Plus or minus 0.2% of rate from 1.6 to 33.0 ft/sec velocity.
 - b. Plus or minus 0.0033 ft/s at flow rates < 1.6 ft/s
 - 12. FT-3100 For locations with adequate 10 pipe diameters upstream & 5 downstream. Accuracy: Flowmeter shall provide calibrated outputs directly from the transmitter, throughout the operating range with the accuracy stated as follows:
 - a. Plus or minus 0.4% of rate from 3.3 to 33.0 ft/sec velocity.

- b. Plus or minus 0.75% of rate from 1.3 to 3.3 ft/s
 - c. Plus or minus 0.0075 ft/s at flow rates < 1.0 ft/s
13. Calibration: Each flowmeter shall receive a wet calibration, within the expected operating range, against a primary volumetric standard directly traceable to international standards in accordance with ISO 9104:1991 and ISO 17025:2005.
 14. Transmitter enclosure shall be cast aluminum, IP67 rated.
 15. Display: Menu driven via three (3) button programming keys and shall include 16 character, 8 line graphic LCD backlit display. Display shall provide instantaneous flow rate information, totalized flow information, flow velocity, flow direction, short term trend data and shall be factory configured for a specific flowmeter application.
 16. Where indicated on drawings, provide MODBUS RS-485 communication for BAS monitoring.
 17. Warranty: Each flowmeter shall be covered by the manufacturer's three-year warranty.
- B. Insertion Type: For locations with adequate 10 pipe diameters upstream & 5 downstream: ONICON Model FT-3400 Insertion Electromagnetic Flowmeter (For FM-x and FM-x locations indicated on the Temperature Control drawings). With following requirements:
1. Description: Provide an insertion electromagnetic flowmeter complete with NIST traceable, wet calibrated flow-measuring element, transmitter, installation valves, adjustable installation depth gauge, and calibration certificate. Flowmeter shall be wet-tappable, allowing insertion and removal from the flow stream without system shutdown.
 2. Application Range: The contractor shall be responsible for selecting the flowmeter options submitted based on the application. Flowmeter shall be constructed, calibrated, and scaled for the intended application in terms of pipe size, pipe material, installation requirements, expected flow rate, ambient conditions, and fluid characteristics which include but are not limited to pressure, temperature, conductivity, and viscosity.
 3. Sensing Technology: Electromagnetic velocity-measuring element.
 4. Design: Electromagnetic sensing element shall utilize two sets of diametrically opposed electrodes to measure the average flow rate velocity.
 5. Construction: Wetted components shall be constructed of 316L stainless steel with an attached tag indicating calibration information. Sensor technology shall have a NEMA4 enclosure.
 6. Maximum Pressure Rating: 400 psig.
 7. Fluid Temperature Rating: 15F to 250 °F.
 8. Ambient Conditions Transmitter: -20F to 150 °F.
 9. Pipe Size Range Standard Configuration: 3 - 72" nominal diameter.
 10. End Connections for NPS 1.25" and Larger: 1" Male NPT Hot Tap Adapter fitting. Installation through 1" full port isolation valve, minimum.
 11. Flow Range: Flow-measuring element and transmitter shall cover the operating range of equipment or system served.
 12. Accuracy: Flowmeter shall provide calibrated outputs directly from the integral transmitter, throughout the operating range with the accuracy stated as follows:
 13. Accuracy: 31.0% of reading from 2 - 20 ft/s | 30.02 ft/s below 2 ft/s
 14. Flow Range: 0.1 ft/s to 20 ft/s (200:1 turndown)
 15. Minimum Conductivity: 25 µS/cm
 16. Calibration: Each flowmeter shall receive a wet calibration, within the expected operating range, against a primary volumetric standard that is traceable to NIST.
 17. Input Power: 20 - 28 VDC, 400 mA at 24 VDC or 20 - 28 VAC, 60 Hz, 10 VA
 18. Analog Outputs: (1) one active 4-20mA, and (1) one 2-10V, or 1-5V. Alarm condition at 2mA for 4-20mA, 1V for 2-10V, or 0.5V for 1-5V analog output.
 19. Digital Outputs: (3) Isolated solid-state dry contacts. (1) one for totalization, (1) one for optional directional contact, and (1) meter master alarm

20. Frequency Output: (0-15V peak pulse, 0-500hz)
21. Operating and Installation Instructions: Installation and operating instructions shall be provided for each flowmeter.
22. Warranty: Each flowmeter shall be covered by a one-year no-fault warranty and three-year manufacturing warranty.
23. Installation:
 - a. Meters shall be installed per the manufacturer's recommendations.
 - b. Install meters and allow space for service and maintenance.
 - c. This contractor shall be responsible for connecting all flow meter-system elements.
 - d. This contractor shall be responsible for connecting the flow meter to any optional display.
24. Commissioning: After installation, commission all meters according to the manufacturer's written instructions.

C. Remote Display: ONICON System 1000 Energy Measurement System (Remote Display application For FM-x and FM-x indicated on the Temperature Control drawings). With following requirements:

1. Micro-processor-based flow computer for configuration and display of remote flowmeters. The measurement system shall be configured for the specific application prior to delivery.
2. Factory programmed for its specific application, and shall be re-programmable using the front panel keypad (no special interface device or computer required).
3. Enclosure: NEMA 13, painted die cast aluminum enclosure, designed for wall or DIN Rail mounting.
4. Backlit Alphanumeric display.
5. Non-Volatile EEPROM memory
6. Power 24VAC or 120-230VAC, electronics shall provide 24 Vdc @ 1000mA power to flow meters and electronics.
7. Calibration and Configuration: Each system shall be factory programmed for the specific application and each metering system component, flow meters, with certificate of calibration, directly traceable to N.I.S.T.
8. Display: Provide an operator interface consisting of four pushbuttons and graphical interface. Display shall visually indicate total fluid volume, instantaneous flow rate, auxiliary flow rate, auxiliary accumulation totals, and alarm contact.
9. Flow Meters: Refer to flow meters selected shall be suitable for the specific application.
10. Listings and Certifications: FCC: Part 15, Subpart B; UL listed.
11. Provide BACnet MS/TP communication for BAS monitoring.
12. Warranty: Each system shall be covered by the manufacturer's three-year warranty and 1 year No-Fault Warranty.
13. Installation:
 - a. System shall be installed according to the manufacturer's recommendations.
 - b. Install panel displays to allow service and maintenance.
 - c. Contractor shall be responsible for connecting all flow meter-system elements.
 - d. Wire per and per all local, state, and federal requirements and NEC requirements After installation, commission all meters according to manufacturer's written instructions.
14. Commissioning: After installation, commission all meters according to manufacturer's written instructions.

2.25 INDICATING GAUGES - DUCT STATIC PRESSURE

- A. 4" diameter dial in metal case, diaphragm actuated, black figures on white background, front recalibration adjustment, scale as indicated on drawings or as appropriate for application, suitable for surface or flush mounting. Accuracy 3 2 % of full scale.
- B. Where indicated on drawings, gauge shall incorporate high and low pressure switches. Switches shall be front adjustable over the full range of the gauge with pointers and with adjustable deadband to 1% of full scale. Separate electrical contacts shall close upon reaching the high or low pressure setpoints.
- C. Manufacturer:
 - 1. Dwyer "Magnehelic" or "Photohelic."

2.26 LIMIT SWITCHES

- A. Oil tight type with operator as required providing required function. Limit switches used on dampers should be set at approximately 75% of full stroke.
- B. Manufacturers:
 - 1. Allen-Bradley.
 - 2. General Electric.
 - 3. Square D.
 - 4. Westinghouse.
 - 5. Micro-switch.

2.27 LOCAL AND AUXILIARY CONTROL COMPONENT ENCLOSURE PANELS

- A. Unitized cabinet type for each system under automatic control with relays and controls mounted in cabinet and temperature indicators, pressure gauges, pilot lights, pushbuttons and switches flush on cabinet panel face, or as detailed on drawings. Provide panel with locking door.
- B. ANSI/NEMA 250, general purpose utility enclosures with enameled finished face panel, or as indicated on the drawings.
- C. Panels shall be sized for a maximum fill of 50% capacity, and shall not be smaller than 24" X 24".

2.28 REFERENCE PROBE - DUCT STATIC PRESSURE

- A. Duct static pressure probe shall be capable of static pressure measurement with bi-directional flow in a duct, plenum or air handling unit. Probe shall have minimum 4" insertion depth, shall compensate for total pressure error, and shall provide an accurate, repeatable and stable static pressure value with a maximum flow of 4000 fpm.
- B. Probe shall be constructed of aluminum, with mounting flange suitable for round or flat duct surfaces. Probe shall have static pressure signal fitting.
- C. Manufacturers:

1. MAMAC # A-520.
2. Dwyer # A-305.
3. Tek-Air # T-SPP 7100/7200.

2.29 REFERENCE PROBE - INDOOR STATIC PRESSURE

- A. Indoor pressure reference probe shall be a shielded static pressure sensor suitable for flush mounting in the ceiling, complete with multiple sensing ports, pressure impulse suppression chamber, airflow shielding, control tubing take-off fitting, and brush finish on exposed surface. Probe shall be capable of sensing the static pressure in the proximity of the sensor to within 1% of the actual pressure value while being subjected to a maximum airflow of 1000 fpm from a radial source.
- B. Manufacturers:
 1. Air Monitor Corporation.
 2. Tek-Air.

2.30 REFERENCE PROBE - OUTDOOR STATIC PRESSURE

- A. Outdoor pressure reference probe shall be constructed of anodized aluminum, with control tubing take-off fitting, which shall be capable of sensing the outside ambient air pressure to within 2% of the actual value when subjected to radial wind velocities up to 80 miles per hour with approach angles up to 30 degrees to the horizontal.
- B. Manufacturers:
 1. Air Monitor Corporation.
 2. Tek-Air.

2.31 THERMOMETERS - AIRSTREAM

- A. ASTM E1, 4 inch diameter dial in stainless steel or drawn steel with enamel finish case, vapor or liquid actuated with brass or copper bulb, copper or bronze braided capillary of sufficient length and with necessary bulb supports within airstream, white with black markings and black pointer, unbreakable lens, 1 percent scale accuracy. Maximum scale divisions shall be 2 deg F. Select scale ranges such that all expected temperatures are within the range but such that the range does not extend beyond the extremes more than 25 degrees.
- B. Manufacturers:
 1. Terrice.
 2. Weksler.
 3. Marsh.
 4. Honeywell.
 5. Schneider Electric Controls.
 6. Johnson Controls.
 7. Siemens.

2.32 THERMOSTATS - ELECTRONIC & ELECTRIC

- A. Electronic Floating Control Room Thermostats: Microprocessor based tri-state (floating)proportional thermostat providing individual room control with setpoint adjustment, locking cover and range stops, output status LED's, night setback/setup feature with local override switch. Manufacturer: Honeywell, Model T6984 or similar.
- B. Electronic Modulating Control Room Thermostats: Microprocessor based modulating 2-10V DC thermostat providing individual room control with setpoint adjustment, locking cover and range stops, output status LED's, night setback/setup feature with local override switch. Capable of single and dual modulating outputs to meet required control application. Manufacturer: Honeywell, Model T7984 or similar.
- C. Line Voltage Room Thermostats: Adjustable single setpoint with exposed setpoint indicator and exposed thermometer for a range of 55 deg F to 85 deg F with maximum dead band of 1-1/2 degrees F, and locking cover. Contacts shall be rated for load, single-pole or two-pole as required. Provide with integral manual On/Off/Auto selector switch where indicated on control details. Power Requirement: 24 V, ac or 120 V, ac as required.
- D. Room Thermostat Accessories:
 - 1. Thermostat Covers: Manufacturers standard with finish as selected by Architect.
 - 2. Insulating Bases: Provide one inch insulating base for thermostats located on exterior walls.
 - 3. Adjusting Key: As required for device.
- E. Electric Low Limit Duct Thermostat (freezestat): Snap acting which trips if temperature sensed across any 12 inches of bulb length is equal to or below setpoint, fixed 5 deg F differential, range 30 deg F to 60 deg F, requiring minimum 20 feet length of bulb. Manual-reset unless indicated on drawings to be auto-reset type. Provide one thermostat for every 20 sq ft of coil surface. Switch shall be UL listed and rated for 10 amps at 120 VAC. Provide additional switch or contacts for connection to monitoring system.
- F. Electric High Limit Duct Thermostat: Snap acting, manual reset switch.
- G. Electric; water-immersion type thermostat, for installation in hot-water circulation piping adjustable for control of water circulation pump. Operation of pump to be On or Off upon setpoint as required per control details. Contacts shall be rated for load. Provide transformer for 24 V, ac or 120 V, ac duty as required.
- H. Electric; strap-on piping type thermostat for control of fans with hot water heating coils. Operation of fan to be Off when temperature is below setpoint as required per control details. Contacts shall be rated for load. Provide transformer for 24 V, ac or 120 V, ac duty as required
- I. Manufacturers for listed Thermostat Types:
 - 1. Honeywell International, Inc.
 - 2. Johnson Controls, Inc.
 - 3. Schneider Electric USA, Inc.
 - 4. Siemens Industry, Inc.; Building Technologies Division.
 - 5. White-Rodgers Div.; Emerson Electric Co.

2.33 WATER FLOW SWITCHES

- A. UL listed, suitable for all service application conditions. Body minimum working pressure rating shall equal or exceed system pressure rating as noted for each system in Division 22 and 23 piping sections.
- B. Manufacturers:
 - 1. ITT.
 - 2. Honeywell.
 - 3. Johnson Controls.

PART 3 - EXECUTION

3.1 INSTALLATION - CONTROL SYSTEMS

- A. Install in accordance with manufacturer's instructions.
- B. Check and verify location of temperature sensors, thermostats and other exposed control sensors with plans and room details before installation. Locate room temperature sensors and thermostats 48 inches above floor unless noted otherwise.
- C. The location of all control-related items to be mounted on the exterior of the building must be approved by the Architect prior to installation. Indicate proposed locations on the shop drawings.
- D. Caulk both sides of damper frames to duct walls to prevent leakage between damper frame and duct.
- E. Mount control panels adjacent to associated equipment on vibration free walls or free standing angle iron supports. Sensors used for closed loop control must be connected to the same DDC controller as the associated output signal.
- F. Provide conduit and electrical wiring where required.
- G. All wiring in altered and unaltered areas shall be run concealed. "Wiremold" in finished areas shall be allowed when wiring cannot be run concealed in walls or partitions. Minimize "wiremold" routing.
- H. Splicing of DDC sensor cabling at junction boxes shall not be acceptable.
- I. All equipment which has moving parts and is remotely started by the control system shall be provided with warning labels no less than 2 inches in height, and in bright warning color, stating that the equipment is remotely started by automatic controls. Such labels shall be posted clearly in the area of any moving parts, such as belts, fans, pumps, etc.
- J. Coil and conceal excess capillary on remote element instruments.
- K. Install thermometers in air duct systems on flanges.
- L. Install all gauges and thermometers in locations where they are easily read from normal floor level. Provide tubing or wiring as required.

- M. Locate all control components and accessories such that they are easily accessible for adjustment, service and replacement.
- N. Locate, size and support sensing elements in airstreams so that they properly sense the representative condition. Controlling, transmitting and indicating elements shall be located to sense the average condition. Safety elements shall be located to sense the extreme condition.
- O. Locate and size sensing elements in liquid lines so that they are in moving liquid and not in stagnant or turbulent locations. Wells shall not obstruct the flow of the liquid being measured. Pipes one inch and smaller shall be increased at least one pipe size at the point of insertion.
- P. Locate pressure sensing taps in liquid lines in straight runs of pipe with at least 10 pipe diameters of straight pipe both upstream and downstream of pressure tap. Provide a shut-off cock in sensing line at each pressure tap.
- Q. Install pressure sensing elements in ducts and casings with clean, sharp taps to accurately read true static pressure, avoiding velocity influence and turbulence.
- R. Locate, support and install all control components and accessories so that they will not be subject to vibration, excessive temperatures, dirt, moisture or other harmful conditions beyond their rated limitations.
- S. Where insulation is penetrated due to the installation of sensing elements or tubing, reseal the openings air and vapor tight. Provide brackets for devices to be located on insulated surfaces so as to clear the finished surface of the insulation and to avoid puncturing the vapor seal.
- T. Provide all necessary relays, switches, linkages, control devices, accessories and connections as required for a complete and operational control system as specified herein and shown.
- U. All electric valve and damper operators shall be capable of moving from full closed to full open, or vice versa, within 120 seconds.

3.2 TC CONTRACTOR DESIGN & INSTALLATION COORDINATION MEETINGS

- A. Temperature Controls Shop Drawing Pre-submittal Meeting: TC Contractor's option to schedule a meeting at the Engineer's Office to review project design documentation for clarification purposes to aide in the TC Contractor development of TC/BAS shop drawings. For simple clarification items, TC Contractor may contact Engineer via telephone to discuss. For project scope questioning items, TC Contractor shall utilize the formal Request of Information (RFI) process.
- B. Temperature Controls Shop Drawing Submittal Meeting: Project Design Engineer's option to schedule a meeting at the Engineer's Office to review the TC Contractor's formally submitted drawings to address Engineer's comments and concerns that indicate TC Contractor's shop drawings vary from project design intent. This meeting can be avoided if TC Contractor's shop drawing submittal is complete and Engineer is confident that documents are going to lead to an installation that meets project design intent.
- C. Temperature Controls Installation Technician Meeting: Project Design Engineer's option to schedule a meeting at the project site to meet and discuss project expectations with the TC Contractor's field installation technician and/or project manager. Discussion may include

1. Shop drawing review comments to ensure installation technician has the most up-to-date TC submittal.
2. Graphics generation requirements including special Owner requirements and schedule for completion.
3. Owner training agenda and scheduling.
4. TC/BAS system acceptance procedures.

3.3 IDENTIFICATION AND MARKING

- A. All sensors, relays, switches, etc. shall be marked with the same identification number as used on the as-built shop drawings. Use Brother P-touch label maker or similar with black text on clear or white super adhesive tape. If label applied in wet environment, spray label with clear enamel for waterproofing.
- B. Wire shall be color coded according to functional use. Identify color coding format on record drawings.
- C. Identify each wire as to ID number at each controller termination, field device termination or on the field device.
- D. All control panels and auxiliary enclosures shall be supplied with engraved phenolic nameplate permanently attached on the front exterior with panel identification to match details of temperature control submittals and include system(s) served and area(s) served on the labeling. Include labeling near 120VAC terminations within panel identifying power source panel ID and specific circuit breaker used.
- E. Temperature control conduit and junction box covers shall be painted grey to signify that it is used for temperature controls. All junction box covers shall be painted grey and the conduit shall be painted with an grey mark (approximately 6 inches long) every 36" to 48", and on both sides of all penetrations.

3.4 GRAPHIC DISPLAY GENERATION

- A. Provide the following graphic displays as a minimum at the operator interface, arranged in logical penetration paths:
 1. Overall campus layout which shows all of the buildings on the Owner's campus.
 2. Individual building layout or isometric for each building connected to the system.
 3. Floor plans for each floor within each building, with display of present values of space conditions sensed by connected space sensors, display of the name of the air handler associated with each space sensor, display of the room number in which the sensor is located and color coding to indicate whether the sensed space condition is within the acceptable range, is too high, or is too low. TC Contractor shall confirm Owner desired room names prior to graphics generation which may differ from the room names indicated on construction documents.
 4. Schematic diagram for each HVAC system. Each system schematic display shall include at least the following:
 - a. Schematic arrangement of ductwork, fans, dampers, coils, valves, piping, pumps, equipment etc.
 - b. System name.
 - c. Area served.
 - d. Present value or status of all inputs, along with present setpoint.
 - e. Present percent open for each damper, valve, etc. based on commanded position.

- f. Reset schedule parameters for all points, where applicable.
 - g. Present occupancy mode.
 - h. Present economizer mode, where applicable.
 - i. Present outside air temperature.
 - j. Associated space conditions and setpoints, where applicable.
 - k. Status of application programs (e.g., warm-up, night cycle, duty cycle, etc.).
 - l. Color coding to indicate normal and abnormal values, alarms, etc.
5. Manual override capability for each on/off or open/closed controlled digital output (for fans, pumps, 2-position dampers and valves, etc.) and each modulating analog output (for dampers, valves, VFD speed modulation type points, etc) shall be provided. Graphic display of output point auto or manual override status shall be provided.
 6. Sequence of operation in written (text) format for each HVAC system.
 7. Overall BAS system schematic.
 8. System management graphic for each network device and/or DDC controller.

3.5 OWNER INSTRUCTION AND TRAINING

- A. Provide a minimum of forty (40) hours of combined on-site and classroom instruction and training to the Owner on the operation of the control systems for the initial installation.
- B. Instruction and training shall be performed by a competent Contractor representative familiar with the control systems operation, maintenance and calibration.
- C. Training shall take place after check, test, start-up of temperature controls system at a time mutually agreed upon by the Owner and Contractor.
- D. Provide computer training & tutorial material on USB Flash Drives 5 total describing operator's BAS graphical interface capabilities and functions.
- E. Provide 5 sets of literature pertaining to the operation and maintenance of the DDC system components provided.

3.6 CALIBRATION AND START-UP

- A. After installation and connection of control components, test, adjust and re-adjust as required all control components in terms of function, design, systems balance and performance. Make systems ready for environmental equipment acceptance tests.
- B. After environmental equipment has been accepted and after the systems have operated in normal service for two weeks, check the adjustment on control components and recalibrate where required. Components not in calibration shall be recalibrated to function as required, or shall be replaced. Control devices, linkages, and other control components shall be calibrated and adjusted for stable and accurate operation in accordance with the design intent and to obtain optimum performance from the equipment controlled. Cause every device to automatically operate as intended to ensure its proper functionality.

3.7 ACCEPTANCE PROCEDURE

- A. Upon successful completion of start-up and recalibration as indicated in this section, the Architect shall be requested in writing to inspect the satisfactory operation of the control systems.
- B. Demonstrate operation of all control systems, including each individual component, to the Owner and Architect.
- C. After correcting all items appearing on the punch list, make a second written request to the Owner and Architect for inspection and approval.
- D. After all items on the punch list are corrected and formal approval of the control systems is provided by the Architect, the Contractor shall indicate to the Owner in writing the commencement of the warranty period.

END OF SECTION 230933

SECTION 231123 - FUEL GAS PIPING

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."

1.2 SUMMARY

- A. This Section includes facility fuel gas piping.
- B. Service meter assemblies will be furnished and installed by utility company.

1.3 DEFINITIONS

- A. Gas Main: Utility's natural gas piping.
- B. Gas Distribution: Piping from gas main to individual service-meter assemblies.
- C. Service-Meter Assembly: Piping, valves, service regulator, service meter, and specialties.
- D. Point of Delivery: Piping outlet from service-meter assembly.
- E. Fuel Gas Piping: Piping that conveys fuel gas from point of delivery to fuel gas utilization devices.

1.4 PERFORMANCE REQUIREMENTS

- A. Minimum Operating-Pressure Ratings:
 - 1. Piping and Valves: Performance requirements are scheduled on the Drawings.
 - 2. Exception: Fuel Gas Piping Installed within Ceilings Used as Plenums: 150 psig .

1.5 SYSTEMS DESCRIPTIONS

- A. Fuel gas piping system materials are scheduled on the Drawing.

1.6 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Specialty valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
 - 2. Pressure regulators. Include pressure rating, capacity, and settings of selected models.

1.7 INFORMATIONAL SUBMITTALS

- A. Shop Drawings: For fuel gas piping. Include plans and attachments to other work.
 - 1. Wiring Diagrams: Power, signal, and control wiring.
- B. Coordination Drawings: Plans and details, drawn to scale, on which natural-gas piping is shown and coordinated with other installations, using input from installers of the items involved.

1.8 CLOSEOUT SUBMITTALS

- A. Field quality-control test reports.
- B. Operation and Maintenance Data: For natural gas specialties and accessories to include in operation and maintenance manuals.

1. Lubricated Plug Valves: Installation, operation, lubrication, and leak testing procedures.

1.9 QUALITY ASSURANCE

- A. Electrical Components and Devices: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.
- B. NFPA Standard: Comply with NFPA 54, "National Fuel Gas Code."

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Handling Flammable Liquids: Remove and legally dispose of liquids from drips in existing gas piping. Handle cautiously to avoid spillage and ignition. Notify fuel gas supplier. Handle flammable liquids used by Installer with proper precautions and do not leave on premises from end of one day to beginning of next day.
- B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.
- D. Protect stored PE pipes and valves from direct sunlight.

1.11 PROJECT CONDITIONS

- A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.
- B. Gas System Pressure: Not more than 5.0 psig.
- C. Design values of fuel gas supplied for these systems are as follows:
 1. Nominal Heating Value: 1000 Btu/cu. ft.
 2. Nominal Specific Gravity: 0.6.

1.12 COORDINATION

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 1. Notify Architect not less than two days in advance of proposed utility interruptions.
 2. Do not proceed with utility interruptions without Architect's written permission.
- B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

- C. Coordinate requirements for access panels and doors for valves installed concealed behind finished surfaces. Comply with requirements in Division 08 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 BLACK STEEL PIPE AND FITTINGS

- A. Black Steel Pipe: ASTM A 53/A 53M or ASTM A 106; Type E or S; Grade B; Schedule 40. Wall thickness of wrought-steel pipe shall comply with ASME B36.10M.
 - 1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern, with threaded ends according to ASME B1.20.1.
 - 2. Steel Threaded Fittings: ASME B16.11, forged steel with threaded ends according to ASME B1.20.1.
 - 3. Steel Welding Fittings: ASME B16.9, wrought steel or ASME B16.11, forged steel.
 - 4. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends according to ASME B1.20.1.
 - 5. Cast-Iron Flanges and Flanged Fittings: ASME B16.1, Class 125.
 - 6. Joint Compound and Tape: Suitable for natural gas.
 - 7. Steel Flanges and Flanged Fittings: ASME B16.5.
 - 8. Gasket Material: Thickness, material, and type suitable for natural gas.

2.3 PIPING SPECIALTIES

- A. Flexible Connectors: ANSI Z21.24, copper alloy.
- B. Quick-Disconnect Devices: ANSI Z21.41, convenience outlets and matching plug connector.
- C. Y-Pattern Strainers:
 - 1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
 - 2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
 - 3. Strainer Screen: 60-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
 - 4. CWP Rating: 125 psig.
- D. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

2.4 JOINING MATERIALS

- A. Refer to Division 20 Section "Basic Mechanical Materials and Methods."

2.5 SPECIALTY VALVES

- A. Valves, NPS 3 and Smaller: Threaded ends according to ASME B1.20.1 for pipe threads.
- B. Valves, NPS 4: Threaded ends according to ASME B1.20.1 for pipe threads; or flanged ends according to ASME B16.5 for steel flanges.
- C. Valves, NPS 6 and Larger: Flanged ends according to ASME B16.5 for steel flanges.
- D. Natural Gas Valves, NPS 3 and Smaller: Use the following:
 - 1. Ball Valves: Bronze or brass body with AGA or CSA stamp, UL listed or FM approved for service, with chrome-plated brass ball and lever handle; 125-psig minimum pressure rating.
 - a. Manufacturers:
 - 1) Apollo Valve; Conbraco Industries, Inc.
 - 2) Jomar International Ltd.
 - 3) Legend Valve and Fitting, Inc.
 - 4) Milwaukee Valve Company.
 - 5) NIBCO INC.
 - 6) Watts Water Technologies, Inc.; Watts Regulator Co.
 - b. Tamperproof Feature: Include design for locking.
- E. Natural Gas Valves, NPS 4: Use any of the following:
 - 1. Cast-Iron, Eccentric Plug Valves:
 - a. Manufacturers:
 - 1) Homestead Valve; a division of Olson Technologies, Inc.; Keycentric Series 300.
 - 2) Milliken Valve Company; Mueller Water Products; Model 625.
 - b. Approvals: UL approved.
 - c. Body: Cast iron, complying with ASTM A 126, Class B.
 - d. Plug: Bronze or nickel-plated cast iron.
 - e. Stem Seal: Compatible with natural gas.
 - f. Resilient Plug Seal: Compatible with natural gas.
 - g. Operator: Square head or lug type with tamperproof feature where indicated.
 - h. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 10 plug valves, for each size square plug head.
 - i. Pressure Class: 125 psig.
 - 2. Cast-Iron, Lubricated Plug Valves: MSS SP-78.
 - a. Manufacturers:
 - 1) Flowserve Nordstrom.

- 2) Homestead Valve; a division of Olson Technologies, Inc.
 - 3) R&M Energy Systems, a Unit of Robbins & Myers, Inc.; Resun.

 - b. Body: Cast iron, complying with ASTM A 126, Class B.
 - c. Plug: Bronze or nickel-plated cast iron.
 - d. Seat: Coated with thermoplastic.
 - e. Stem Seal: Compatible with natural gas.
 - f. Operator: Square head or lug type with tamperproof feature where indicated.
 - g. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 10 plug valves, for each size square plug head.
 - h. Pressure Class: 125 psig.
- F. Natural Gas Valves, NPS 6 and Larger: Use any of the following:
- 1. Cast-Iron, Lubricated Plug Valves: MSS SP-78.
 - a. Manufacturers:
 - 1) Flowserve Nordstrom.
 - 2) Homestead Valve; a division of Olson Technologies, Inc.
 - 3) R&M Energy Systems, a Unit of Robbins & Myers, Inc.; Resun.

 - b. Body: Cast iron, complying with ASTM A 126, Class B.
 - c. Plug: Bronze or nickel-plated cast iron.
 - d. Seat: Coated with thermoplastic.
 - e. Stem Seal: Compatible with natural gas.
 - f. Operator: Square head or lug type with tamperproof feature where indicated.
 - g. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 10 plug valves, for each size square plug head.
 - h. Pressure Class: 125 psig.

 - 2. Class 150, Full-Port, Carbon-Steel Ball Valves:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Apollo Valve; Conbraco Industries, Inc.; 88A-200-UL Series.
 - 2) Metso Automation; Jamesbury Valves.

 - b. UL listed.
 - c. Split-body construction.
 - d. Chrome-plated carbon steel ball.
 - e. Reinforced PTFE seats.
 - f. Lever actuation.

PART 3 - EXECUTION

3.1 EXCAVATION

- A. Refer to Division 31 Section "Earthwork" for excavating, trenching, and backfilling.

3.2 EXAMINATION

- A. Examine roughing-in for fuel gas piping system to verify actual locations of piping connections before equipment installation.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 PREPARATION

- A. Close equipment shutoff valves before turning off natural gas to premises or piping section.
- B. Inspect natural-gas piping according to NFPA 54 and the International Fuel Gas Code to determine that natural-gas utilization devices are turned off in piping section affected.
- C. Comply with NFPA 54 and the International Fuel Gas Code requirements for prevention of accidental ignition.

3.4 SERVICE-METER ASSEMBLY INSTALLATION

- A. Service meter assembly will be installed by the fuel gas utility company.
- B. Install gas valve or plug valve and strainer upstream from each service pressure regulator.
- C. Install service pressure regulators with vent outlet turned down and with corrosion-resistant-metal insect screen.
- D. Install pressure gage upstream and downstream from each service pressure regulator. Pressure gages are specified in Division 20 Section "Meters and Gages."
- E. Install service meters downstream from service pressure regulators.
 - 1. Service meters with connections larger than NPS 1 supported from piping or set on concrete bases.

3.5 SERVICE ENTRANCE PIPING

- A. Extend fuel gas piping and connect to fuel gas distribution for service entrance to building.
 - 1. Exterior fuel gas distribution system piping, service pressure regulator, and service meter will be provided by gas utility.
 - 2. Refer to Article entitled "Codes, Permits and Fees" in Division 20 Section "Mechanical General Requirements" for additional requirements.
- B. Install dielectric fitting downstream from and adjacent to each service meter unless meter is supported from service-meter bar with integral dielectric fitting. Install shutoff valve downstream from and adjacent to dielectric fitting. Dielectric fittings are specified in Division 20 Section "Basic Mechanical Materials and Methods."

3.6 PIPING SYSTEM INSTALLATION

- A. Comply with NFPA 54 and the International Fuel Gas Code for installation and purging of natural-gas piping.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Basic piping installation requirements are specified in Division 20 Section "Basic Mechanical Materials and Methods."
- D. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels, unless indicated to be exposed to view.
- E. Concealed Locations:
 - 1. Above Inaccessible Ceiling Locations: Gas piping with welded joints may be installed in inaccessible spaces, subject to approval of authorities having jurisdiction, whether or not such spaces are used as plenums. Do not locate valves or unions above inaccessible ceilings.
 - 2. Above Accessible Ceiling Locations: Gas piping with welded joints may be installed in accessible ceiling spaces, subject to approval of authorities having jurisdiction, whether or not such spaces are used as plenums. Do not locate valves or unions above ceilings used as plenums.
 - 3. In Floor Channels: Gas piping may be installed in floor channels, subject to approval of authorities having jurisdiction. Channels must have cover and be open to space above cover for ventilation.
 - 4. Underground Beneath Building: Gas piping may be installed in protective conduit in accordance with Chapter "Gas Piping Installations" in the International Fuel Gas Code.
 - 5. In Partitions: Do not install concealed piping in solid partitions, unless installed in a chase or casing.
 - a. Exception: Piping passing through partitions or walls.
 - 6. In Walls: Gas piping with welded joints and protective wrapping specified in Part 2 "Protective Coating" Article may be installed in masonry walls, subject to approval of authorities having jurisdiction.
 - 7. Prohibited Locations: Do not install gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
- F. Drips and Sediment Traps: Install drips at points where condensate may collect. Include outlets of service meters. Locate where readily accessible for cleaning and emptying. Do not install where condensate would be subject to freezing.
 - 1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use minimum-length nipple of 3 pipe diameters, but not less than 3 inches long, and same size as connected pipe. Install with space between bottom of drip and floor for removal of plug or cap.
- G. Install fuel gas piping at uniform grade of 0.1 percent slope upward toward risers.
- H. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

- I. Connect branch piping from top or side of horizontal piping.
- J. Install strainer on inlet of each automatic and electrically operated valve.
- K. Install pressure gage upstream and downstream from each line pressure regulator. Pressure gages are specified in Division 20 Section "Meters and Gages."
- L. Locate valves for easy access.
- M. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment, and elsewhere as indicated. Unions are not required on flanged devices.
- N. Install flanges when connecting to valves, specialties, and equipment having NPS 2-1/2 and larger connections.
- O. Install gas valve or plug valve and strainer upstream from each line pressure regulator or appliance pressure regulator.
- P. Install vent piping for gas pressure regulators and gas trains, extend outside building, and vent to atmosphere. Terminate vents with turned-down, reducing-elbow fittings with corrosion-resistant insect screens in large end.
- Q. Install containment conduits for gas piping below slabs, within building, in gastight conduits extending minimum of 4 inches outside building, and vented to atmosphere. Terminate vents with turned-down, reducing-elbow fittings with corrosion-resistant insect screens in large end. Prepare and paint outside of conduits with coal-tar, epoxy-polyamide paint according to SSPC-Paint 16.

3.7 JOINT CONSTRUCTION

- A. Basic piping joint construction is specified in Division 20 Section "Basic Mechanical Materials and Methods."
- B. Use materials suitable for fuel gas.
- C. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

3.8 HANGER AND SUPPORT INSTALLATION

- A. Pipe hanger and support and equipment support materials and installation requirements are specified in Division 20 Section "Hangers and Supports."
- B. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
 - 1. NPS 1 and Smaller: Maximum span, 96 inches; minimum rod size, 3/8 inch.
 - 2. NPS 1-1/4: Maximum span, 108 inches; minimum rod size, 3/8 inch.
 - 3. NPS 1-1/2 and NPS 2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
 - 4. NPS 2-1/2 to NPS 3-1/2: Maximum span, 10 feet; minimum rod size, 1/2 inch.
 - 5. NPS 4 and Larger: Maximum span, 10 feet; minimum rod size, 5/8 inch.
- C. Support vertical steel pipe at each floor and at spacing not greater than 15 feet.

3.9 CONNECTIONS

- A. Drawings indicate general arrangement of fuel gas piping, fittings, and specialties.
- B. Install piping adjacent to appliances to allow service and maintenance.
- C. Connect piping to appliances using gas with shutoff valves and unions. Install valve upstream from and within 72 inches of each appliance. Install union downstream from valve.
- D. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance using gas.
- E. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each service meter, pressure regulator, and specialty valve.
 - 1. Text: In addition to name of identified unit, distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.
 - 2. Nameplates, pipe identification, and signs are specified in Division 20 Section "Mechanical Identification."
 - 3. Trace Wire: Yellow insulated, minimum 18 AWG wire, having copper or other approved conductor, with insulation suitable for direct burial, installed adjacent to underground nonmetallic piping, with aboveground access to tracer wire at each end of pipe.

3.10 PAINTING

- A. Use materials and procedures in Division 09 painting Sections.
- B. Paint exposed, exterior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.
 - 1. Alkyd System: MPI EXT 5.1D.
 - a. Prime Coat: Alkyd anticorrosive metal primer.
 - b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
 - c. Topcoat: Exterior alkyd enamel.
 - d. Color: Safety yellow.
- C. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

3.11 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base.
 - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
 - 2. 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 the base.

3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Use 3000-psi, 28-day, compressive-strength concrete and reinforcement as specified in Division 03.

3.12 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 1. Test, inspect, and purge natural gas according to NFPA 54 and the International Fuel Gas Code and authorities having jurisdiction.
- C. Additional Testing: Subject welded fuel gas piping installed within ceiling spaces used as plenums to test pressure of 150 psi for a minimum of 2 hours.
- D. Natural-gas piping will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

END OF SECTION 231123

SECTION 232113 - HYDRONIC PIPING

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 07 Section "Penetration Firestopping" for materials and methods for sealing pipe penetrations through fire and smoke barriers.
 - 2. Division 07 Section "Joint Sealants" for materials and methods for sealing pipe penetrations through exterior walls.
 - 3. Division 20 Section "Mechanical General Requirements."
 - 4. Division 20 Section "Basic Mechanical Materials and Methods" for general piping materials and installation requirements.
 - 5. Division 20 Section "Hangers and Supports" for pipe supports, product descriptions, and installation requirements. Hanger and support spacing is specified in this Section.
 - 6. Division 20 Section "Pipe Flexible Connectors, Expansion Fittings and Loops."
 - 7. Division 20 Section "Meters and Gages" for thermometers, flow meters, flow measuring devices, and pressure gages.

8. Division 20 Section "Mechanical Identification" for labeling and identifying hydronic piping.
9. Division 23 Section "General-Duty Valves for HVAC" for general-duty gate, globe, ball, butterfly, and check valves.
10. Division 23 Section "Hydronic Pumps" for pumps, motors, and accessories for hydronic piping.
11. Division 23 Section "Temperature Controls" for temperature-control valves and sensors.
12. Division 23 Section "Piping Systems Flushing and Chemical Cleaning."
13. Division 23 HVAC water treatment sections.
14. Division 33 Section "Underground Hydronic Distribution Piping" for preinsulated piping systems.

1.2 DEFINITIONS

- A. CPVC: Chlorinated polyvinyl chloride.
- B. HDPE: High density polyethylene.
- C. PP: Polypropylene.
- D. PVC: Polyvinyl chloride.
- E. PTFE: Polytetrafluoroethylene.
- F. RTRF: Reinforced thermosetting resin (fiberglass) fittings.
- G. RTRP: Reinforced thermosetting resin (fiberglass) pipe.

1.3 PERFORMANCE REQUIREMENTS

- A. Where not indicated on the Drawings, hydronic piping components and installation shall be capable of withstanding the following minimum working pressures and temperatures:

1.4 SYSTEMS DESCRIPTIONS

- A. Hydronic piping system materials are scheduled on the Drawings.
- B. Refer to Application Schedule on the Drawings for valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 1. Hot-Water-Piping, Balancing Duty: Calibrated balancing valves.
 2. Drain Duty: Hose-end drain valves.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of the following:
 1. Valves. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
 2. Air control devices.
 3. Chemical treatment.

4. Hydronic specialties.

1.6 INFORMATIONAL SUBMITTALS

- A. Shop Drawings: Detail, at minimum 1/4scale, the piping layout, fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops.
- B. Qualification Data: For Installer.
- C. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at Project site.

1.7 CLOSEOUT SUBMITTALS

- A. Field quality-control test reports.
- B. Operation and Maintenance Data: For air control devices, hydronic specialties, and special-duty valves to include in operation and maintenance manuals.

1.8 QUALITY ASSURANCE

- A. ASME Compliance: Comply with ASME B31.9, "Building Services Piping" for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

1.9 EXTRA MATERIALS

- A. Water-Treatment Chemicals: Furnish enough chemicals for initial system startup and for preventive maintenance for one year from date of Substantial Completion.
- B. Differential Pressure Meter: For each type of balancing valve and automatic flow control valve, include flowmeter, probes, hoses, flow charts, and carrying case.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.
- B. Annealed-Temper Copper Tubing: ASTM B 88, Type K.
- C. DWV Copper Tubing: ASTM B 306, Type DWV.
- D. Wrought-Copper Socket Fittings: ASME B16.22.
- E. Wrought-Copper Unions: ASME B16.22.

2.2 STEEL PIPE AND FITTINGS

- A. Schedule 40 Steel Pipe: ASTM A 53/A 53M or ASTM A 106, Type E or S, Grade A or B. Include ends matching joining method.
 - 1. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, seamless steel pipe. Include ends matching joining method.
 - 2. Malleable-Iron Unions: ASME B16.39, Class 150, hexagonal-stock body, with ball-and-socket, metal-to-metal, bronze seating surface and female threaded ends.
 - 3. Gray-Iron, Threaded Fittings: ASME B16.4, Class 125, standard pattern.
 - 4. Cast-Iron Flanges: ASME B16.1, Class 125.
 - 5. Cast-Iron, Flanged Fittings: ASME B16.1, Class 125.
 - 6. Fittings: ASTM A234 ANSI B16.9, steel butt weld to match pipe wall thickness, Class 300.
 - 7. Flanges: Class 300 forged steel welding neck to match pipe wall thickness and valve flanges, ANSI B16.5. Orifice plate flanges shall be raised face welding neck type with ring joint gaskets and flange taps. Coordinate orifice plate flanges with orifice plate flow elements.

2.3 JOINING MATERIALS

- A. Refer to Division 20 Section "Basic Mechanical Materials and Methods."

2.4 VALVES

- A. General Service Valves: Comply with requirements specified in Division 23 Section "General-Duty Valves for HVAC."

2.5 SPECIALTY VALVES

- A. Balance Valves:
 - 1. Balance Valves NPS 6 and Larger: Lug type butterfly valves with aluminum bronze disc, AISI 300 Series stainless steel stem, resilient replaceable seat for service at not less than 250 deg F and memory stops. Refer to Division 23 Section "General-Duty Valves for HVAC" for additional requirements.
 - a. Provide lubricated enclosed screw or worm gear operator with handwheel for sizes 6 inches and larger.
 - b. Pressure rating shall meet or exceed system minimum pressure rating.
 - 2. Flow Measuring: Use Flow Measuring Devices as specified in Division 20 Section "Meters and Gages."
 - 3. Balance Valves for Sizes Less than NPS 6 Combination balance valve and flow measuring device as specified in this Section.
- B. Combination, Balancing Valves and Flow Measuring Devices NPS 2 and Smaller:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Griswold Controls.
 - b. Hydronic Components, Inc. (HCi); a Jomar Group Company.
 - c. IMI Flow Design; IMI Hydronic Engineering Inc.

- d. Jomar Hydronics.
 - e. Macon Balancing; Tunstall Corporation.
 - f. Nexus Valve.
 - g. PRO Hydronic Specialties, LLC.
2. Manufacturers: Subject to compliance with requirements, use products by one of the following:
 - a. Tour & Andersson; TA Hydronics Series available through Victaulic Company of America.
 - b. ASC Engineered Solutions; Gruvlok; Model CBV.
 3. Body: Brass or bronze, ball or plug type with calibrated orifice or venturi.
 4. Ball: Plated brass, or stainless steel.
 5. Plug: Resin.
 6. Seat: PTFE.
 7. End Connections: Threaded or socket.
 8. Pressure Gage Connections: Integral seals for portable differential pressure meter.
 9. Handle Style: Lever, with memory stop to retain set position.
 10. WOG Rating: Minimum 400 psig.
 11. Maximum Operating Temperature: 250 deg F.
- C. Combination, Balancing Valves and Flow Measuring Devices NPS 2-1/2 through NSP 4:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Griswold Controls.
 - b. Hydronic Components, Inc. (HCi); a Jomar Group Company.
 - c. IMI Flow Design; IMI Hydronic Engineering Inc.
 - d. Jomar Hydronics.
 - e. Macon Balancing; Tunstall Corporation.
 - f. Nexus Valve.
 - g. PRO Hydronic Specialties, LLC.
 2. Body: Cast-iron or steel body, ball, plug, butterfly, or globe pattern with calibrated orifice or venturi.
 3. Stem Seals: EPDM O-rings.
 4. Disc: Glass and carbon-filled PTFE.
 5. Seat: PTFE.
 6. End Connections: Flanged or grooved.
 7. Pressure Gage Connections: Integral seals for portable differential pressure meter.
 8. Handle Style: Lever, with memory stop to retain set position.
 9. WOG Rating: Minimum 200 psig.
 10. Maximum Operating Temperature: 225 deg F.
- D. Contractor Option for Combination, Balancing Valves and Flow Measuring Devices NPS 2 and Smaller: Preassembled coil hook up kits may be used.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Griswold Controls.
 - b. Hydronic Components, Inc. (HCi); a Jomar Group Company.
 - c. IMI Flow Design; IMI Hydronic Engineering Inc.
 - d. Jomar Hydronics.

- e. Macon Balancing; Tunstall Corporation.
- f. Nexus Valve.
- g. PRO Hydronic Specialties, LLC.

2.6 CONTROL VALVES

- A. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Division 23 Section "Temperature Controls."
- B. Calibrated orifice balancing valves shall not be required on devices where pressure independent characterized control valves (PICCV's) are installed.

2.7 AIR CONTROL DEVICES

- A. Manual Air Vents: Use ball-valve-type hose-end drain valves, refer to Division 23 Section "General-Duty Valves for HVAC."
- B. Automatic Air Vents:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett; Xylem Inc.
 - d. Spirotherm, Inc.
 - e. Taco, Inc.
 - 2. Body: Bronze or cast iron.
 - 3. Internal Parts: Nonferrous.
 - 4. Operator: Noncorrosive metal float.
 - 5. Inlet Connection: NPS 1/2.
 - 6. Discharge Connection: NPS 1/4.
 - 7. Maximum Operating Pressure: 150 psig.
 - 8. Maximum Operating Temperature: 240 deg F.
- C. Expansion Tanks:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett; Xylem Inc.
 - d. Taco, Inc.
 - e. Wessels Co.
 - 2. Tank: Welded steel, rated for 125-psig working pressure and 375 deg F maximum operating temperature, with taps in bottom of tank for tank fitting and taps in end of tank for gage glass. Tanks shall be factory tested with taps fabricated and labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
 - 3. Air-Control Tank Fitting: Cast-iron body, copper-plated tube, brass vent tube plug, and stainless-steel ball check, 100-gal. unit only; sized for compression-tank diameter. Provide tank fittings for 125-psig working pressure and 250 deg F maximum operating temperature.

4. Tank Drain Fitting: Brass body, nonferrous internal parts; 125-psig working pressure and 240 deg F maximum operating temperature; constructed to admit air to compression tank, drain water, and close off system.
5. Gage Glass: Full height with dual manual shutoff valves, 3/4-inch- diameter gage glass, and slotted-metal glass guard.

D. Diaphragm-Type Expansion Tanks:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett; Xylem Inc.
 - d. Taco, Inc.
 - e. Wessels Co.
2. Tank: Welded steel, rated for 125-psig working pressure and 240 deg F maximum operating temperature. Factory test with taps fabricated and supports installed and labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
3. Diaphragm: Securely sealed into tank to separate air charge from system water to maintain required expansion capacity.
4. Air-Charge Fittings: Schrader valve, stainless steel with EPDM seats.

E. Combination Air and Dirt Separators:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Spirotherm, Inc.; VDN Series.
2. Body: Fabricated steel; constructed for 150-psig maximum working pressure and 250 deg F maximum operating temperature. Separator shall have body extended below pipe connections for dirt separation and include removable lower head.
3. Air and Dirt Separation Mechanism: Internal copper core tube with continuous wound copper medium permanently attached followed by continuous wound copper wire permanently affixed .
4. Venting Chamber: With integral full port, float actuated brass venting mechanism. Include valved side tap to flush floating dirt or liquids and for quick bleeding of air during system fill.
5. Inlet and Outlet Connections: Threaded for NPS 2 and smaller; flanged connections for NPS 2-1/2 and larger.
6. Blowdown Connection: Threaded.
7. Size: Match system flow capacity.

2.8 STEEL, CHILLED WATER BUFFER TANKS

A. Manufacturers:

1. Adamson Global Technology Corporation.
2. Amtrol, Inc.
3. Armstrong Pumps, Inc.
4. Cemline Corporation.
5. Highland Tank & Mfg. Co.
6. Taco, Inc.

- B. Description: Steel, vertical pressure-rated tank with cylindrical sidewalls.
- C. Construction: ASME code, steel, constructed with nontoxic welded joints, for 125-psig working pressure, and internal baffle to prevent short circuiting.
- D. Connections and Tappings: Factory-fabricated steel, welded to tank before testing and labeling.
 - 1. NPS 2 and Smaller: ASME B1.20.1, with female thread.
 - 2. NPS 2-1/2 and Larger: ASME B16.5, flanged.
- E. Include connections and tappings for the following:
 - 1. Inlet.
 - 2. Outlet.
 - 3. Factory mounted air vent.
- F. Tank Supports: Factory-fabricated steel legs or steel skirt, welded to tank before testing and labeling.
- G. Exterior Coating: Primer paint and manufacturers standard finish color with factory installed 1/2-inch thick elastomeric thermal insulation.

2.9 HYDRONIC PIPING SPECIALTIES

- A. Diverting Fittings: 125-psig working pressure; 250 deg F maximum operating temperature; cast-iron body with threaded ends, or wrought copper with soldered ends. Indicate flow direction on fitting.
- B. Flexible connectors and expansion fittings are specified in Division 20 Section "Pipe Flexible Connectors, Expansion Fittings and Loops."
- C. Waterless Condensate Trap:
 - 1. Meet standard building code requirements.
 - 2. Predesigned to prevent:
 - a. Possibility of frozen or broken pipes.
 - b. Standing water within trap.
 - c. Sludge buildup in trap.
 - d. Geyser effect or blowout.
 - 3. Manufacturers:
 - a. Des Champs Technologies; HVAC Air Trap; P-Series, N-Series, and RLC Series.

2.10 HYDRONIC PIPING STRAINERS

- A. Manufacturers:
 - 1. Apollo Valves; Conbraco Industries, Inc.
 - 2. Griswold Controls.
 - 3. Keckley Company.
 - 4. Metraflex Company.

5. Mueller Steam Specialty; a Watts Brand.
6. NIBCO, Inc.
7. Sure Flow Equipment Inc.
8. Titan Flow Control, Inc.
9. Watts.
10. Yarway; Emerson Automation Solutions.

B. Y-Pattern Strainers, Bronze:

1. CWP: 200 psig minimum, unless otherwise indicated.
2. SWP: 125 psig minimum, unless otherwise indicated.
3. Body: Bronze for NPS 2 and smaller.
4. End Connections: Threaded or soldered.
5. Strainer Screen: Stainless steel, 40-mesh unless otherwise noted or scheduled.
6. Drain:
 - a. Pipe plug for sizes NPS 2 and smaller.
 - b. Factory-installed, hose-end drain valve for sizes NPS 2-1/2 and larger.

C. Y-Pattern Strainers, Cast and Ductile Iron:

1. Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
2. Strainer Screen: Stainless steel, 40-mesh unless otherwise noted or scheduled.
3. CWP: 200 psig minimum, unless otherwise indicated.
4. SWP: 125 psig minimum, unless otherwise indicated.
5. Drain:
 - a. Pipe plug for sizes NPS 2 and smaller.
 - b. Factory-installed, hose-end drain valve for sizes NPS 2-1/2 and larger.

D. Basket Strainers, Cast Iron:

1. Body: ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: Stainless steel, 40-mesh unless otherwise noted or scheduled.
4. CWP: 200 psig minimum, unless otherwise indicated.
5. SWP: 125 psig minimum, unless otherwise indicated.
6. Drain: Factory-installed, hose-end drain valve.

2.11 FILTRATION EQUIPMENT

A. Multimedia Filters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Diamond Water Systems, Inc.
 - b. Everfilt.
 - c. LAKOS; a div. of Claude Laval Corporation.
 - d. Miami Filter LLC.
 - e. Nalco; an Ecolab Company.
 - f. PEP Filters, Inc.
 - g. Puroflux Corporation.
 - h. United Industries, Inc.; Tower-Flo Water Filter Systems.

2. Description: Factory-fabricated and -tested, simplex, multimedia filter system of filter tank, media, strainer, circulating pump, piping, and controls for removing particles from water.
 - a. Filter Tank: Corrosion resistant with distribution system and media.
 - 1) Fabricate and label steel filter tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
 - 2) Fabricate and label FRP filter tanks to comply with ASME Boiler and Pressure Vessel Code: Section X, if indicated.
 - 3) Pipe Connections NPS 2 and Smaller: Threaded according to ASME B1.20.1.
 - 4) Steel Tank Pipe Connections NPS 2-1/2 and Larger: Steel, Class 150 flanges according to ASME B16.5 or grooved according to AWWA C606.
 - 5) FRP Tank Pipe Connections NPS 2-1/2 and Larger: Type A, integral; Designation E, 125-psig pressure category flanges of grade same as tank material according to ASTM D 5421.
 - b. Motorized Valves: Flanged or grooved-end, ductile-iron butterfly type with EPDM valve seat and stem seal; with ASTM B 148 aluminum bronze disc.
 - c. Strainer: Basket type mounted on pump suction.
 - d. Piping: ASTM A 53/A 53M, Type S, F, or E; Grade B, Schedule 40 black steel, with flanged, grooved, or threaded joints and malleable, steel welding, or ductile-iron fittings.
 - e. Piping: ASTM B 88, Type L copper water tube, copper-alloy solder-joint fittings, and brazed, flanged, or grooved joints.
 - f. Safety Valves: Automatic pressure relief.
 - g. Circulating Pump: Overhung impeller, close coupled, single stage, end suction, centrifugal. Comply with UL 778 and with HI 1.1-1.2 and HI 1.3.
 - 1) Casing: Radially split, cast iron.
 - 2) Pressure Rating: 125 psig minimum.
 - 3) Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, closed, and keyed to shaft.
 - 4) Shaft and Shaft Sleeve: Steel shaft, with copper-alloy shaft sleeve.
 - 5) Seal: Mechanical.
 - 6) Motor: ODP motor supported on the pump-bearing frame. General requirements for motors are specified in Division 20 Section "Motors."
 - h. Controls: Automatic control of circulating pump and tank backwash; factory wired for single electrical connection.
 - 1) Panel: NEMA 250, Type 4 enclosure with time clock and pressure gages.
 - 2) Pump: Automatic and manual switching; manual switch position bypasses safeties and controls.
 - 3) Backwash: Automatic; with time clock and differential pressure switch.
 - 4) Backwash Valve: Tank mounted with valves interlocked to single actuator.
 - i. Support: Skid mounting.
3. Capacities and Characteristics: Refer to Schedule on Drawings.

B. Cartridge-Type Filters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cycron Corporation.
 - b. Eden Equipment Company; Excel Filters.
 - c. Filter Specialists, Inc.
 - d. Harmsco Industrial Filters; HIF Series with 801 Series Cartridges.
 - e. Hayward Industrial Products, Inc.
 - f. Nalco; an Ecolab Company.
 - g. Parker Hannifin Corp.; Process Filtration Div.
 - h. PEP Filters, Inc.
 - i. Plymouth Products, Inc.
 - j. RainSoft Div.; Aquion Partners L. P.
 - k. Rosedale Products, Inc.
 - l. RPA Process Technologies.
 - m. Shelco Filters; division of Tinny Corp.
 - n. USFilter Corporation.
 2. Description: Floor-mounting housing with filter cartridges for removing particles from water.
 - a. Housing: Corrosion resistant; designed to separate inlet from outlet and to direct inlet through cartridge-type water filter; with base, feet, or skirt.
 - 1) Pipe Connections NPS 2 and Smaller: Threaded according to ASME B1.20.1.
 - 2) Steel Housing Pipe Connections NPS 2-1/2 and Larger: Steel, Class 150 flanges according to ASME B16.5 or grooved according to AWWA C606.
 - 3) Plastic Housing Pipe Connections NPS 2-1/2 and Larger: 150-psig plastic flanges.
 - b. Cartridge: Replaceable; of shape to fit housing.
 3. Capacities and Characteristics: Refer to Schedule on Drawings.
- C. Packaged Side Stream Centrifugal Separators:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Alamo Water Treatment; Ecodyne Water Treatment, Inc.
 - b. Culligan International.
 - c. Griswold Controls.
 - d. LAKOS; a div. of Claude Laval Corporation.
 - e. PEP Filters, Inc.
 - f. Puroflux Corporation.
 - g. Rosedale Products, Inc.
 - h. USFilter Corporation.
 2. Description: Simplex separator housing with baffles and chambers for removing particles from water by centrifugal action and gravity.
 3. Housing: With manufacturer's proprietary system of baffles and chambers.
 - a. Construction: Fabricate and label steel separator housing to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
 - b. Inlet: Designed with tangential entry to produce centrifugal flow of feedwater.

- c. Vortex Chamber: Designed for downward vortex flow and gravity separation of particles.
 - d. Collection Chamber: Designed to hold separated particles.
 - e. Outlet: Near top of unit.
 - f. Purge: At bottom of collection chamber.
 - g. Pipe Connections NPS 2 and Smaller: Threaded according to ASME B1.20.1.
 - h. Pipe Connections NPS 2-1/2 and Larger: Steel, Class 150 flanges according to ASME B16.5 or grooved according to AWWA C606. Provide stainless-steel flanges if tank is stainless steel.
4. Motorized Purge Valve: Gate or plug pattern valve.
 - a. Motorized Valves: Butterfly-type, flanged or grooved-end, ductile-iron body, with EPDM valve seat and stem seal; with ASTM B 148 aluminum bronze disc.
 5. Strainer: Stainless-steel basket type mounted on pump suction.
 6. Piping: ASTM A 53/A 53M, Type S, F, or E; Grade B, Schedule 40 black steel, with flanged, grooved, or threaded joints and malleable, steel welding, or ductile-iron fittings.
 7. Circulating Pump: Overhung impeller, close coupled, single stage, end suction, centrifugal. Comply with UL 778 and with HI 1.1-1.2 and HI 1.3.
 - a. Casing: Radially split, cast iron.
 - b. Pressure Rating: 125 psig minimum.
 - c. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, closed, and keyed to shaft.
 - d. Shaft and Shaft Sleeve: Steel shaft, with copper-alloy shaft sleeve.
 - e. Seal: Mechanical.
 - f. Motor: ODP motor supported on the pump-bearing frame. General requirements for motors are specified in Division 20 Section "Motors."
 8. Controls: Automatic control of circulating pump and separator purge; factory wired for single-point electrical connection.
 - a. Panel: NEMA 250, Type 4 enclosure.
 - b. Pump: Automatic and manual switching; manual switch position bypasses safeties and controls.
 - c. Separator Purge: Automatic and manual.
 - d. TDS Controller Interlock: Open separator purge valve with bleed-off control.
 9. Support: Skid mounting.
 10. Capacities and Characteristics: Refer to Schedule on Drawings.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

- B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Select system components with pressure rating equal to or greater than system operating pressure.
- K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
- M. Install piping, other than drain piping, at a uniform grade of 0.2 percent upward in direction of flow.
- N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
- O. Install branch connections to mains using tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.
- P. Install valves according to Division 23 Section "General-Duty Valves for HVAC."
- Q. Install shutoff duty valves at each branch connection to supply mains, at supply connection to each piece of equipment, unless only one piece of equipment is connected in the branch line. Install throttling duty valves at each branch connection to return mains, at return connections to each piece of equipment, and elsewhere as indicated.
- R. Install calibrated balancing valves in the return water line of each heating or cooling element and elsewhere as required to facilitate system balancing.
- S. Install check valves at each pump discharge and elsewhere as required to control flow direction.
- T. Install safety valves on hot-water generators and elsewhere as required by the ASME Boiler and Pressure Vessel Code. Install safety-valve discharge piping, without valves, to floor. Comply with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, for installation requirements.

- U. Install pressure-reducing valves on hot-water generators and elsewhere as required to regulate system pressure.
- V. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
- W. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.
- X. Install strainers on inlet side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and where indicated. Install NPS 3/4 nipple and ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2.
- Y. Install expansion loops, expansion joints, anchors, and pipe alignment guides as specified in Division 20 Section "Pipe Flexible Connectors, Expansion Fittings and Loops."
- Z. Identify piping as specified in Division 20 Section "Mechanical Identification."

3.2 HANGERS AND SUPPORTS

- A. Hanger, support, and anchor devices are specified in Division 20 Section "Hangers and Supports." Comply with the following requirements for maximum spacing of supports.
- B. Install the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
 - 2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
 - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
 - 4. Spring hangers to support vertical runs.
 - 5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
- C. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
 - 1. NPS 3/4: Maximum span, 7 feet; minimum rod size, 1/4 inch.
 - 2. NPS 1: Maximum span, 7 feet; minimum rod size, 1/4 inch.
 - 3. NPS 1-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
 - 4. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
 - 5. NPS 2-1/2: Maximum span, 11 feet; minimum rod size, 3/8 inch.
 - 6. NPS 3: Maximum span, 12 feet; minimum rod size, 3/8 inch.
 - 7. NPS 4: Maximum span, 14 feet; minimum rod size, 1/2 inch.
 - 8. NPS 6: Maximum span, 17 feet; minimum rod size, 1/2 inch.
 - 9. NPS 8: Maximum span, 19 feet; minimum rod size, 5/8 inch.
 - 10. NPS 10: Maximum span, 20 feet; minimum rod size, 3/4 inch.
 - 11. NPS 12: Maximum span, 23 feet; minimum rod size, 7/8 inch.
 - 12. NPS 14: Maximum span, 25 feet; minimum rod size, 1 inch.
 - 13. NPS 16: Maximum span, 27 feet; minimum rod size, 1 inch.
 - 14. NPS 18: Maximum span, 28 feet; minimum rod size, 1-1/4 inches.
 - 15. NPS 20: Maximum span, 30 feet; minimum rod size, 1-1/4 inches.

- D. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
 - 1. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
 - 2. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
 - 3. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
 - 4. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
 - 5. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
 - 6. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.
 - 7. NPS 4 to NPS 5: Maximum span, 10 feet minimum rod size, 1/2-inch.
 - 8. NPS 6: Maximum span, 10 feet minimum rod size, 5/8-inch.
 - 9. NPS 8: Maximum span, 10 feet minimum rod size, 3/4-inch.
- E. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.3 PIPE JOINT CONSTRUCTION

- A. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.

3.4 HYDRONIC SPECIALTIES INSTALLATION

- A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.
- B. Install automatic air vents at high points of system piping in mechanical equipment rooms only. Manual vents at heat-transfer coils and elsewhere as required for air venting.
- C. Glycol Systems:
 - 1. Install automatic air vents on expansion tanks and install high capacity automatic air vents on air separators. Route vent piping to spill over glycol fill station.
 - 2. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.
- D. Install piping from boiler air outlet, air separator, or air purger to expansion tank with a 2 percent upward slope toward tank.
- E. Install in-line air separators in pump suction. Install drain valve on air separators NPS 2 and larger.
- F. Install combination air/dirt separator in pump suction. Install blowdown piping with ball valve; extend full size to nearest floor drain.
- G. Install bypass chemical feeders in each hydronic system where indicated, in upright position with top of funnel not more than 48 inches above the floor. Install feeder in minimum NPS 3/4 bypass line, from main with full-size, full-port, ball valve in the main between bypass connections. Install NPS 3/4 pipe from chemical feeder drain, to nearest equipment drain and include a full-size, full-port, ball valve.
- H. Install expansion tanks as indicated in piping diagrams. Install tank fitting in tank bottom and charge tank. Use manual vent for initial fill to establish proper water level in tank.

1. Install tank fittings that are shipped loose.
2. Support tank from floor or structure above with sufficient strength to carry weight of tank, piping connections, fittings, plus tank full of water. Do not overload building components and structural members.
3. Vent and purge air from hydronic system, and ensure tank is properly charged with air to suit system Project requirements.

3.5 TERMINAL EQUIPMENT CONNECTIONS

- A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.
- B. Install control valves in accessible locations close to connected equipment.
- C. Install ports for pressure gages and thermometers at coil inlet and outlet connections according to Division 20 Section "Meters and Gages."

3.6 FIELD QUALITY CONTROL

- A. Prepare hydronic piping according to ASME B31.9 and as follows:
 1. Leave joints, including welds, uninsulated and exposed for examination during test.
 2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
 3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
 4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
 5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.
- B. Perform the following tests on hydronic piping:
 1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
 2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
 3. Isolate expansion tanks and determine that hydronic system is full of water.
 4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
 5. After hydrostatic test pressure has been applied for at least 2 hours, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
 6. Prepare written report of testing.

C. Perform the following before operating the system:

1. Open manual valves fully.
2. Inspect pumps for proper rotation.
3. Remove disposal fine-mesh strainers in pump suction diffusers.
4. Set makeup pressure-reducing valves for required system pressure.
5. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
6. Set temperature controls so all coils are calling for full flow.
7. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
8. Verify lubrication of motors and bearings.

END OF SECTION 232113

SECTION 232123 - HYDRONIC PUMPS

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."

1.2 DEFINITIONS

- A. Buna-N: Nitrile rubber.
- B. EPT: Ethylene propylene terpolymer.
- C. PEI: Pump Energy Index as defined by the Department of Energy.
- D. PEI_{CL}: Pump Energy Index - Constant Load, as defined by the Department of Energy.
- E. PEI_{VL}: Pump Energy Index - Variable Load, as defined by the Department of Energy.

1.3 ACTION SUBMITTALS

- A. Product Data: Include certified performance curves and rated capacities, operating characteristics, furnished specialties, final impeller dimensions, and accessories for each type of product indicated. Indicate pump's operating point on curves.

1.4 INFORMATIONAL SUBMITTALS

- A. Shop Drawings: Show pump layout and connections. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.
 - 1. Wiring Diagrams: Power, signal, and control wiring.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For all pumps and accessories to include in Operation and Maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain hydronic pumps through one source from a single manufacturer.
- B. Department of Energy Requirements: Pumps supplied that are regulated by the Department of Energy pump standards shall bear the acceptable PEI index.
 - 1. Constant load pumps supplied shall bear the acceptable PEI_{CL} index.
 - 2. Variable load pumps supplied with variable speed controls shall bear the acceptable PEI_{VL} index.
 - 3. Submittals for approval shall clearly identify the applicable PEI index and affirm that that index meets the DOE pump standards.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.
- D. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Manufacturer's Preparation for Shipping: Clean flanges and exposed machined metal surfaces and treat with anticorrosion compound after assembly and testing. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed-in plugs.
- B. Store pumps in dry location.
- C. Retain protective covers for flanges and protective coatings during storage.
- D. Protect bearings and couplings against damage from sand, grit, and other foreign matter.
- E. Comply with pump manufacturer's written rigging instructions.

1.8 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

PART 2 - PRODUCTS

2.1 GENERAL PUMP REQUIREMENTS

- A. Pump Units: Factory assembled and tested.
- B. Motors: Comply with requirements in Division 20 Section "Motors".
- C. Selection:
 - 1. Base non-overloading characteristics for pumps upon nameplate horsepower, at any point on performance curve.
 - 2. Shaft first critical speed shall not be less than 25 percent greater than operating speed.
 - 3. Maximum impeller diameter shall not be greater than 90 percent of "cut water" diameter for a given casing and no smaller than the smallest published diameter for casing. Do not base acceptable maximum diameter calculation on percentage of impeller diameter range for a given casing.
 - 4. Pump speed shall be limited to 1800 RPM except as scheduled.
 - 5. Select at the point of maximum efficiency for a given impeller-casing combination. Deviations shall be within 3 percent of maximum efficiency on the increasing capacity side of the maximum efficiency point and 7 percent on the decreasing capacity side of the maximum efficiency point.
 - 6. Select pump at a point no greater than 85 percent of end of curve flow.
 - 7. Maximum pump suction velocity:
 - a. In-line: 12 fps .
 - b. End suction: 13 fps .
 - c. Double suction: 15 fps .

2.2 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.3 CLOSE-COUPLED, IN-LINE CENTRIFUGAL PUMPS (SMALL)

- A. Manufacturers:
 - 1. Armstrong Pumps Inc.
 - 2. Bell & Gossett; Xylem Inc.; Series PL.
 - 3. Grundfos Pumps Corporation.
 - 4. Taco, Inc.

- B. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, close-coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3; and designed for installation with pump and motor shafts mounted horizontally.
 - 1. Pump Construction: Bronze fitted.
 - a. Casing: Radially split, cast iron, with threaded companion-flange connections.
 - b. Impeller: Glass-reinforced corrosion-resistant material; keyed to shaft.
 - c. Shaft: High-strength alloy steel.
 - d. Seal: Mechanical, carbon/silicon carbide seal.
 - e. Bearings: Permanently oil-lubricated type.
 - 2. Motor-Single speed, with oil-lubricated bearings, unless otherwise indicated; and directly mounted to pump casing. Comply with requirements in Division 20 Section "Motors."
- C. Capacities and Characteristics: Refer to Schedule on Drawings.

2.4 SMALL CLOSE-COUPLED, IN-LINE CENTRIFUGAL PUMPS

- A. Manufacturers:
 - 1. Armstrong Pumps Inc.
 - 2. Bell & Gossett; Xylem Inc.; Series e-90.
 - 3. Grundfos Pumps Corporation.
 - 4. Taco, Inc.
- B. Description: Factory-assembled and tested, centrifugal, overhung-impeller, close-coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally or vertically. Rate pump for 175-psig minimum working pressure and a continuous water temperature of 225 deg F.
- C. Pump Construction:
 - 1. Casing: Radially split, cast iron, with threaded gage tappings at inlet and outlet, and companion-flange connections.
 - 2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. Trim impeller to match specified performance.
 - 3. Pump Shaft: Steel with copper-alloy shaft sleeve, or stainless steel.
 - 4. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N seal for all glycol systems and all water systems 225 deg F and below; EPT seals for water systems above 225 deg F. Include water slinger on shaft between motor and seal.
- D. Motor: Single speed, with permanently or grease lubricated ball bearings, unless otherwise indicated; and rigidly mounted to pump casing. Comply with requirements in Division 20 Section "Motors."

2.5 CLOSE-COUPLED, IN-LINE CENTRIFUGAL PUMPS

- A. Manufacturers:
 - 1. Armstrong Pumps Inc.; Series 4360 and 4380.

2. Bell & Gossett; Xylem Inc.; Series e-80.
 3. Grundfos Pumps Corporation.
 4. Taco, Inc.; Series 1900 Series.
- B. Description: Factory-assembled and tested, centrifugal, overhung-impeller, close-coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally or vertically. Rate pump for 175-psig minimum working pressure and a continuous water temperature of 225 deg F.
- C. Pump Construction:
1. Casing: Radially split, cast iron, with threaded gage tappings at inlet and outlet, and companion-flange connections.
 2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. Trim impeller to match specified performance.
 3. Pump Shaft: Steel with copper-alloy shaft sleeve, or stainless steel.
 4. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N seal for all glycol systems and all water systems 225 deg F and below; EPT seals for water systems above 225 deg F. Include water slinger on shaft between motor and seal.
- D. Motor: Single speed, with permanently or grease lubricated ball bearings, unless otherwise indicated; and rigidly mounted to pump casing. Comply with requirements in Division 20 Section "Motors"
- E. Capacities and Characteristics: Refer to Schedule on Drawings.

2.6 FLEXIBLY COUPLED, BASE-MOUNTED, END-SUCTION CENTRIFUGAL PUMPS

- A. Manufacturers:
1. Armstrong Pumps Inc.; Series 4030.
 2. Aurora Pump; Division of Pentair Pump Group; Series 3340.
 3. Bell & Gossett; Xylem Inc.; Series e-1510.
 4. Grundfos Pumps Corporation/PACO.
 5. Taco, Inc.; Series FI.
- B. Description: Factory-assembled and tested, centrifugal, overhung-impeller, separately coupled, end-suction pump as defined in HI 1.1-1.2 and HI 1.3; designed for base mounting, with pump and motor shafts horizontal. Rate pump for 175-psig minimum working pressure and a continuous water temperature of 225 deg F.
- C. Pump Construction:
1. Casing: Radially split, cast iron, with threaded gage tappings at inlet and outlet, drain plug at bottom and air vent at top of volute, and flanged connections. Provide integral mount on volute to support the casing, and attached piping to allow removal and replacement of impeller without disconnecting piping or requiring the realignment of pump and motor shaft true back pullout. Provide replaceable bronze wear rings for all pumps with pump shaft L/D ratios greater than 6.0.
 2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. Trim impeller to match specified performance.
 3. Pump Shaft: Steel, with copper-alloy shaft sleeve or stainless steel.

4. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N seal for all glycol systems and all water systems 225 deg F and below; EPT seals for water systems above 225 deg F. Include water slinger on shaft between motor and seal.
 5. Pump Bearings: Permanently or grease-lubricated ball bearings contained in cast-iron housing with grease fittings.
- D. Flexible Shaft Coupling: Molded rubber insert and interlocking spider capable of absorbing vibration. Couplings shall be center drop-out type to allow disassembly and removal without removing pump shaft or motor. Provide EPDM coupling sleeve for all motors 40 HP and below and all variable-speed applications.
 - E. Coupling Guard: Dual rated; ANSI B15.1, Section 8; OSHA 1910.219 approved; steel; removable; attached to mounting frame.
 - F. Mounting Frame: Welded-steel frame and cross members, factory fabricated from ASTM A 36/A 36M channels and angles. Fabricate to mount pump casing, coupling guard, and motor.
 - G. Motor: Single speed, with permanently lubricated or grease-lubricated ball bearings, unless otherwise indicated; secured to mounting frame, with adjustable alignment. Comply with requirements in Division 20 Section "Motors".
 - H. Capacities and Characteristics: Refer to Schedule on Drawings.
- 2.7 AUTOMATIC CONDENSATE PUMP UNITS (PLENUM APPLICATIONS)
- A. Manufacturers:
 1. Hartell Pumps Div.; Milton Roy Co.; Model A2-X-1965.
 - B. Description: Packaged units with corrosion-resistant pump, dual-voltage thermally protected motor, cast aluminum tank with cover, and automatic controls. Include auxiliary safety switch and factory- or field-installed check valve.
- 2.8 PUMP SPECIALTY FITTINGS
- A. Suction Diffuser: Angle pattern, minimum 175-psig pressure rating, cast-iron body and end cap for NPT or flanged connections or ductile iron body and end cap for grooved connections, pump-inlet fitting; with bronze startup and bronze or stainless-steel permanent strainers; bronze or stainless-steel straightening vanes; drain plug; and integral locating boss for field-fabricated support.
 1. Manufacturers:
 - a. Armstrong Pumps, Inc.
 - b. Bell & Gossett; Xylem Inc.
 - c. Grundfos Pumps Corporation/PACO.
 - d. Mueller Steam Specialty Company.
 - e. Taco; Fabricated Products Division.
 - f. Anvil International, Inc. (grooved only).
 - g. Victaulic Co. of America (grooved only).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.
- C. Examine foundations and inertia bases for suitable conditions where pumps are to be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PUMP INSTALLATION

- A. Comply with HI 1.4.
- B. Install pumps with access for periodic maintenance including removal of motors, impellers, couplings, and accessories.
- C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.
- D. Support in-line centrifugal pumps greater than 1/2 HP independent of piping. Use continuous-thread hanger rods and hangers of sufficient size to support pump weight. Do not support pump from motor housing plate.
- E. Refer to Division 20 Section "Mechanical Vibration Controls" for vibration isolation devices.
- F. Refer to Division 20 Section "Hangers and Supports" for hanger and support materials.
- G. Set base-mounted pumps on concrete bases. Disconnect flexible coupling before setting. Do not reconnect flexible couplings until alignment procedure is complete.
 - 1. Support pump baseplate on rectangular stainless steel blocks and shims, or on wedges with small taper, at points near foundation bolts to provide a gap of 3/4 to 1-1/2 inches between pump base and foundation for grouting.
 - 2. Adjust metal supports or wedges until pump and driver shafts are level. Check coupling faces and suction and discharge flanges of pump to verify that they are level and plumb.
 - 3. Install pumps on inertia bases where required. Refer to Division 20 Section "Mechanical Vibration Controls" for vibration isolation devices.
- H. Automatic (Cooling Coil) Condensate Pump Units: Install units for collecting condensate and extend to open drain.

3.3 ALIGNMENT

- A. Align pump and motor shafts and piping connections after setting on foundation, grout has been set and foundation bolts have been tightened, and piping connections have been made.
- B. Comply with pump and coupling manufacturers' written instructions.
- C. Adjust pump and motor shafts for angular and offset alignment by methods specified in." Laser align to a tolerance of 0.0005 inches maximum.
- D. After alignment is correct, tighten foundation bolts evenly but not too firmly.
- E. Completely fill baseplate with nonshrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

3.4 CONNECTIONS

- A. Piping installation requirements are specified in other Division 20 and 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to machine to allow service and maintenance.
- C. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.
- D. Install check valve and throttling valve on discharge side of pumps. Triple-duty valves are not allowed.
- E. Install Y-type strainer or suction diffuser and shutoff valve on suction side of pumps as indicated on drawings.
- F. Install flexible connectors on suction and discharge sides of base-mounted pumps between pump casing and valves.
- G. Install pressure gages on pump suction and discharge or at integral pressure-gage tapings, or install single gage with multiple-input selector valve.
- H. Install check valve and gate or ball valve on each condensate pump unit discharge.
- I. Install electrical connections for power, controls, and devices.
- J. Ground equipment according to Division 26 Section "Grounding and Bonding."
- K. Connect wiring according to Division 26 Section "Conductors and Cables."

3.5 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service for each pump supplied. Written report of the start-up shall be provided to the Owner and Engineer upon completion of services.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Check piping connections for tightness.

3. Clean strainers on suction piping.
4. Perform the following startup checks for each pump before starting:
 - a. Verify bearing lubrication.
 - b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
 - c. Verify that pump is rotating in the correct direction.
5. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
6. Start motor.
7. Open discharge valve slowly.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain hydronic pumps.

END OF SECTION 232123

SECTION 232513 - WATER TREATMENT FOR CLOSED-LOOP HYDRONIC SYSTEMS

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."
 - 3. Division 23 Section "Piping Systems Flushing and Chemical Cleaning."

1.2 DEFINITIONS

- A. CPVC: Chlorinated Polyvinyl Chloride.
- B. EEPROM: Electrically erasable, programmable read-only memory.
- C. EPDM: Ethylene-propylene-diene monomer.
- D. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.
- E. RO: Reverse osmosis.

- F. TDS: Total dissolved solids.
- G. TSS: Total suspended solids are solid materials, including organic and inorganic, that are suspended in the water. These solids may include silt, plankton, and industrial wastes.
- H. PTFE: Polytetrafluoroethylene.
- I. UV: Ultraviolet.

1.3 PERFORMANCE REQUIREMENTS

- A. Furnish the services of a firm specializing in hydronic piping system water treatment work.
 - 1. This firm shall furnish and administer glycol for systems using glycol/water mix.
- B. Water quality for HVAC systems shall minimize corrosion, scale buildup, and biological growth for optimum efficiency of HVAC equipment without creating a hazard to operating personnel or the environment.
- C. Base HVAC water treatment on quality of water available at Project site, HVAC system equipment material characteristics and functional performance characteristics, operating personnel capabilities, and requirements and guidelines of authorities having jurisdiction.
- D. Base chemical quantities on estimated system size.
- E. Closed hydronic systems, including chilled water, shall have the following water qualities:
 - 1. pH: Maintain a value within 9.0 to 10.5.
 - 2. "P" Alkalinity: Maintain a value within 100 to 500 ppm.
 - 3. Boron: Maintain a value within 100 to 200 ppm.
 - 4. Chemical Oxygen Demand: Maintain a maximum value of 100 ppm.
 - 5. Soluble Copper: Maintain a maximum value of 0.20 ppm.
 - 6. TDS: Maintain a maximum value of 5000 mmhos.
 - 7. Free Caustic Alkalinity: Maintain a maximum value of 20 ppm.
 - 8. Scale Control: Provide sufficient scale inhibitors to prevent formation of scale and maintain all scale-forming material in solution.
 - 9. Microbiological Limits:
 - a. Total Aerobic Plate Count: Maintain a maximum value of 1000 organisms/ml.
 - b. Total Anaerobic Plate Count: Maintain a maximum value of 100 organisms/ml.
 - c. Ammonia: Maintain a maximum value of 20 ppm.
 - d. Nitrate Reducers: Maintain a maximum value of 100 organisms/ml.
 - e. Sulfate Reducers: Maintain a maximum value of 0 organisms/ml.
 - f. Iron Bacteria: Maintain a maximum value of 0 organisms/ml.
 - g. Total Hardness: Maintain a value less than ?? ppm.

1.4 ACTION SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for the following products:
 - 1. Bypass feeders.
 - 2. Chemical test equipment.
 - 3. Chemical material safety data sheets.

1.5 INFORMATIONAL SUBMITTALS

- A. Shop Drawings: Pretreatment and chemical treatment equipment showing tanks, maintenance space required, and piping connections to HVAC systems. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Wiring Diagrams: Power and control wiring.
- B. Other Informational Submittals:
 - 1. Water-Treatment Program: Written sequence of operation on an annual basis for the application equipment required to achieve water quality defined in the "Performance Requirements" Article above.
 - 2. An analytical review of make-up water characteristics for each treated system operating conditions, including such items as Langlier/Ryzner Indexes. Based on this review, provide a definitive description of treatment system developed to achieve specified objectives and include generic terms to describe product formulation content and function. Detailed proprietary formulation data is not required. However, manufacturer's standard published literature is not usually acceptable.
 - 3. A step-by-step procedure to be followed by the Contractor during flushing, purging, disinfecting, draining, disposal, pretreatment and treatment operations. The intent of the step-by-step procedure is two-fold.
 - a. To assure that all essential permanent provisions to accomplish the above work are included during the course of construction.
 - b. To allow the Owner to accomplish the source procedures as subsequent maintenance operations.
- C. Provide OSHA equivalent materials form for hazardous substances.

1.6 CLOSEOUT SUBMITTALS

- A. Field quality-control test reports including final water quality test reports:
 - 1. Boiler water samples taken at one-week intervals after boiler startup for a period of five weeks, and test report advising Owner of changes necessary to adhere to Part 1 "Performance Requirements" Article for each required characteristic. Boiler water taken at eight -week intervals following the testing noted above to show that heating systems are maintaining water quality within performance requirements specified in this Section.
 - 2. Samples taken at eight -week intervals following Substantial Completion, on hydronic systems to show that systems are maintaining water quality within performance requirements specified in this Section. Submit written reports of water analysis advising Owner of changes necessary to adhere to Part 1 "Performance Requirements" Article.

- B. Operation and Maintenance Data: For sensors, injection pumps, and controllers to include in operation and maintenance manuals.
1. Submit under provisions of Division 20 Section "Mechanical General Requirements" and as supplemented in this Section.
 2. Submit following operation and maintenance data as minimum for purified water system.
 - a. Furnish complete instruction manuals for installation, operation, maintenance, and lubrication requirements for each component of mechanical and electrical equipment or system.
 - b. Each instruction manual shall include, but not be limited to, the following:
 - 1) Diagrams and illustrations.
 - 2) Detailed description of the function of each principal component of the system.
 - 3) Performance and nameplate data.
 - 4) Installation instructions.
 - 5) Procedures for starting.
 - 6) Proper adjustment.
 - 7) Test procedures and recording of operation data.
 - 8) Procedures for operating.
 - 9) Shutdown and restart instructions.
 - 10) Emergency operating instructions and trouble-shooting guide.
 - 11) Safety precautions.
 - 12) Maintenance and overhaul instructions which shall include detailed assembly drawings with part numbers, recommended spare parts list, instructions for ordering spare parts (including suppliers names), and complete preventive maintenance instructions required to ensure satisfactory performance and longevity of the equipment.
 - 13) Lubrication instructions, which shall list points to be greased or oiled, shall recommend type, grade, and temperature range of lubricants, and shall recommend frequency of lubrication.
 - 14) List of electrical relay settings and control and alarm contact settings.
 - 15) Electrical interconnection wiring diagram for equipment furnished, including all control.
 - c. Manual shall be complete in all respects for all equipment, controls, accessories, and associated appurtenances.
 - d. Each O&M Manual shall be transmitted to the Owner's representative and Architect prior to installation of the equipment and all equipment shall be serviced by the manufacturer in accordance with the manufacturer's recommendations prior to operation. A service record shall be maintained on each item of equipment and shall be delivered to the Owner's representative and Architect prior to final acceptance of the project.

1.7 QUALITY ASSURANCE

- A. HVAC Water-Treatment Service Provider Qualifications: An experienced HVAC water-treatment service provider capable of analyzing water qualities, installing water-treatment equipment, and applying water treatment as specified in this Section.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.

- C. Regulatory Requirements: Conform to applicable codes for addition of non-potable chemicals to building mechanical systems, and for delivery to public sewage systems.

1.8 OWNER'S INSTRUCTIONS

- A. Provide a coordinated water treatment training program oriented to the needs common to operating personnel and maintenance personnel and to the needs of maintenance personnel only, sufficiently prior to acceptance of the work, upon mutually satisfactory arrangement with the Architect.
- B. Provide a total of not less than eight "field" hours encompassing mechanical, electrical, chemical, pollution and safety aspects, sufficient for personnel to operate and maintain systems and consistently achieve specified objectives, with subsequently scheduled guidance by the water treatment laboratory.
- C. Water treatment laboratory chemical engineer, complemented by instrument engineer, supplemented by Contractor's staff, shall comprise the training staff.
- D. Training materials shall include "survey," limits control program, shop drawings, operating and maintenance manuals, safe handling of chemicals, chemical testing, use of log sheets and demonstrations of installed and functioning systems.
- E. On completion of the installation of the entire purified water system, conduct a thorough check and test of all components in the system. During this period, instruct the Owner's personnel in the theory, operation, and maintenance of the system. When this work is finished, start up the system and operate it for as long as necessary to complete two consecutive days of operation at the specified performance levels. During this period, continue to instruct the Owner's personnel.

1.9 MAINTENANCE SERVICE

- A. Scope of Maintenance Service: Provide chemicals and service program to maintain water conditions required above to inhibit corrosion, scale formation, and biological growth for cooling, chilled-water piping heating, hot-water piping and equipment. Services and chemicals shall be provided for a period of one year from date of Substantial Completion, and shall include the following:
 - 1. Provide piping/plumbing recommendation to optimize chemical program results.
 - 2. Initial water analysis and HVAC water-treatment recommendations.
 - 3. Startup assistance for Contractor to flush the systems, clean with detergents, and initially fill systems with required chemical treatment prior to operation.
 - 4. Quarterly field service and consultation.
 - 5. Customer report charts and log sheets.
 - 6. Laboratory technical analysis.
 - 7. Analyses and reports of all chemical items concerning safety and compliance with government regulations.
- B. Glycol manufacturer shall provide testing services every six months of samples submitted by the Owner. Fluid shall be tested at no charge for: glycol percent, pH, reserve alkalinity, dissolved metals, magnesium, calcium, chlorides, acidity, and inhibitor components. Testing service shall be for the life of the fluid.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers/Suppliers: Unless otherwise specified, and subject to compliance with requirements, provide products by one of the following:
1. Ashland Specialty Chemical Company; Drew Industrial Div.
 2. Enerco Corporation.
 3. SUEZ Water Technologies & Solutions
 4. DuBois Chemicals.
 5. NALCO Water, an Ecolab Company.
 6. H-O-H Chemicals, Inc.

2.2 MANUAL CHEMICAL-FEED EQUIPMENT

- A. Bypass Feeders: Steel, with corrosion-resistant exterior coating, minimum 3-1/2-inch fill opening in the top, and NPS 3/4 bottom inlet and top side outlet. Quarter turn or threaded fill cap with gasket seal and diaphragm to lock the top on the feeder when exposed to system pressure in the vessel.
1. Capacity: 2 gal.
 2. Minimum Working Pressure: 125 psig.

2.3 GLYCOL FEED SYSTEM

- A. Manufacturers:
1. Armstrong Pumps Inc.; GLA Series.
 2. Bell & Gossett; Xylem Inc.; GMU.
 3. H.V. Burton Co.; J.L. Wingert Co.
 4. John Wood Company (The); Automatic Glycol Make-Up System JWGP-54-055.
 5. Advantage Controls inc.; AGF Series.
 6. Skidmore Pump.
- B. Description: Pre-piped and pre-wired system, consisting of a glycol pump, tank, adjustable differential pressure switch, pressure gage, and control panel.
- C. Chemical Tank Assembly:
1. Tank: Industrial grade polyethylene with removable cover.
 2. Tank Capacity: 50 to 55 gallons.
 3. Support Frame: Welded steel.
 4. Discharge Piping: ASTM A53 black or galvanized steel, or Type L copper. PVC or CPVC discharge piping is unacceptable.
 5. Include suction strainer, drain fitting, and interconnecting suction piping to the chemical pump.
 6. Containment: Low profile, forkliftable, spill pallet or containment basin with volume large enough to hold contents of largest tank.
 - a. Construction: High-density polyethylene.
 - b. Grates: Removable with non-slip surface.

- D. Glycol Pump: Positive displacement type with capacity adjustable through 100 percent of range by means of an easily accessible control. The pump shall be adjustable while running, and the pumped fluid shall not contact any metals of the drive assembly. Pump motor maximum 1/2 horsepower, 115 volts/single-phase/60 hertz, with a minimum capacity of 1.5 GPH at discharge pressure minimum 20 percent greater than the indicated system pressure at point of fill,
- E. Hand/Off/Auto Motor Starters: Mounted on skid for glycol pump.
- F. Control Panel: Furnished with the chemical tank assembly. Control panel shall be the master control center for all electrical equipment associated with the chemical tank assembly and shall include:
 - 1. Hand/Off/Auto Switch: For the glycol pump. The pump shall run continuously while the switch is in the HAND position.
 - 2. LED Indicator: For loss of pressure.
 - 3. Enclosure: NEMA 250 Type 4X, with all controls, switches, and indicating lights mounted on the front.
 - 4. Power Connection: Minimum 6-foot power cord and cap.
 - 5. Low Tank Level Interlock Alarm Circuit: To prevent the glycol pump from running dry. Circuit shall include pump lockout, tank level detector, visual alarm, audible alarm, and alarm silence button. Interlock circuit shall automatically reset when tank is refilled.

2.4 CHEMICAL TREATMENT TEST EQUIPMENT

- A. Test Kit: Manufacturer-recommended equipment and chemicals in a wall-mounting cabinet for testing pH, TDS, inhibitor, chloride, alkalinity, and hardness; sulfite and testable polymer tests for high-pressure boilers, and oxidizing biocide test for open cooling systems.
- B. Corrosion Test-Coupon Assembly (Corrosion Racks): Constructed of corrosive-resistant material, complete with piping, valves, and mild steel and copper coupons. Locate copper coupon downstream from mild steel coupon in the test-coupon assembly.
 - 1. Two-station rack for closed-loop systems.
 - 2. Include three feet per second flow control valve.

2.5 CHEMICALS

- A. Chemicals shall be as recommended by water-treatment system manufacturer that are compatible with piping system components and connected equipment, and that can attain water quality specified in Part 1 "Performance Requirements" Article.
- B. Inhibited Propylene Glycol: Single nationally marketed brand of propylene glycol, inhibited for industrial applications, and readily available in bulk quantities from a firm offering free testing and advisory service to bulk users as to inhibitor replenishment needs. Premix inhibited glycol solution and deionized water to specified concentration. Automotive anti-freeze is unacceptable.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Dow Chemical; Dowfrost HD.
 - b. Houghton Chemical Corporation.

- c. Interstate Chemical Company; Intercool P300.
- d. NALCO Water, an Ecolab Company.
- e. PVS-Nolwood Chemicals, Inc.; Chill PGHD.

PART 3 - EXECUTION

3.1 WATER ANALYSIS

- A. Perform an analysis of supply water to determine quality of water available at Project site.

3.2 INSTALLATION

- A. Install chemical application equipment on concrete bases, level and plumb. Maintain manufacturer's recommended clearances. Arrange units so controls and devices that require servicing are accessible. Anchor chemical tanks and floor-mounting accessories to substrate.
- B. Install water testing equipment on wall near water chemical application equipment.
- C. Install meters and equipment requiring service at a maximum 60 inches above finished floor.
- D. Install interconnecting control wiring for chemical treatment controls and sensors.
- E. Mount sensors and injectors in piping circuits.
- F. Install in closed hydronic systems, including hot-water heating chilled water, and equipped with the following:
 - 1. Install cartridge filter in a bypass circuit on main header having pressure differential greater than or equal to 20 psig, unless otherwise indicated on Drawings.
 - 2. Install water meter in makeup water supply.
 - 3. Install test-coupon assembly in bypass circuit around circulating pumps, unless otherwise indicated on Drawings.
 - 4. Install a gate or full-port ball isolation valves on inlet, outlet, and drain below feeder inlet.
 - 5. Install a swing check on inlet after the isolation valve.
- G. Install glycol feed system in accordance with manufacturer's instructions.

3.3 CHEMICAL INSTALLATION

- A. Utilize softened or reverse osmosis water for initial system fill
- B. Add specified chemicals to meet performance requirement specified in Part 1 of this Section.

3.4 GLYCOL INSTALLATION

- A. Clean and flush glycol system before adding premixed glycol solution.

- B. Fill systems indicated to have antifreeze or glycol solutions with the following premixed concentrations. Batch feeding of glycol is prohibited.
 - 1. Chilled-Water Piping: Minimum 30 percent propylene glycol.
 - 2. Snow Melting System: Minimum 50 percent propylene glycol.
- C. Perform tests determining strength of glycol and water solution and submit written test results.

3.5 CONNECTIONS

- A. Piping installation requirements are specified in other Division 20 and 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Make piping connections between HVAC water-treatment equipment and dissimilar-metal piping with dielectric fittings. Dielectric fittings are specified in Division 20 Section "Basic Mechanical Materials and Methods."
- D. Install make-up water meters where indicated on the drawings.
- E. Install shutoff valves on HVAC water-treatment equipment inlet and outlet. Metal general-duty valves are specified in Division 20 Section "Valves."
- F. Refer to Division 22 Section "Domestic Water Piping Specialties" for backflow preventers required in makeup water connections to potable-water systems.
- G. Confirm applicable electrical requirements in Division 26 Sections for connecting electrical equipment.
- H. Ground equipment according to Division 26 Section "Grounding and Bonding."
- I. Connect wiring according to Division 26 Section "Conductors and Cables."

3.6 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.
- B. Perform tests and inspections and prepare test reports.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:
 - 1. Inspect field-assembled components and equipment installation, including piping and electrical connections.
 - 2. Inspect piping and equipment to determine that systems and equipment have been cleaned, flushed, and filled with water, and are fully operational before introducing chemicals for water-treatment system.

3. Place HVAC water-treatment system into operation and calibrate controls during the preliminary phase of HVAC systems' startup procedures.
 4. Do not enclose, cover, or put piping into operation until it is tested and satisfactory test results are achieved.
 5. Test for leaks and defects. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 6. Leave uncovered and unconcealed new, altered, extended, and replaced water piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
 7. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow test pressure to stand for four hours. Leaks and loss in test pressure constitute defects.
 8. Repair leaks and defects with new materials and retest piping until no leaks exist.
- D. Equipment will be considered defective if it does not pass tests and inspections.
- E. Remove and replace malfunctioning units and retest as specified above.
- F. Sample boiler water at one-week intervals after boiler startup for a period of five weeks, and prepare test report advising Owner of changes necessary to adhere to Part 1 "Performance Requirements" Article for each required characteristic. Sample boiler water at eight -week intervals following the testing noted above to show that automatic chemical-feed systems are maintaining water quality within performance requirements specified in this Section.
- G. At eight -week intervals following Substantial Completion, perform separate water analyses on hydronic systems to show that automatic chemical-feed systems are maintaining water quality within performance requirements specified in this Section. Submit written reports of water analysis advising Owner of changes necessary to adhere to Part 1 "Performance Requirements" Article.
- H. Comply with ASTM D 3370 and with the following standards:
1. Silica: ASTM D 859.
 2. Steam System: ASTM D 1066.
 3. Acidity and Alkalinity: ASTM D 1067.
 4. Iron: ASTM D 1068.
 5. Water Hardness: ASTM D 1126.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC water-treatment systems and equipment.

END OF SECTION 232513

SECTION 233113 - METAL DUCTS

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 23 Section "Nonmetal Ducts" for fabric ducts, fibrous-glass ducts, thermoset FRP ducts, thermoplastic ducts, PVC ducts, and concrete ducts.
 - 3. Division 23 Section "HVAC Casings" for factory- and field-fabricated casings for mechanical equipment.
 - 4. Division 23 Section "Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.2 SUMMARY

- A. This Section includes metal ducts for supply, return, outside, relief air, and exhaust air-distribution systems.
- B. Products Installed but Not Furnished Under This Section:
 - 1. Receive, handle, and install terminal boxes furnished by the Laboratory Airflow Controls Contractor. Refer to Division 23 Section "Laboratory Airflow Controls."

1.3 DEFINITIONS

- A. Duct Sizes: Inside clear dimensions. For lined ducts, maintain sizes inside lining.
- B. Low Pressure: Up to and including 2 inch WG and velocities less than 1,500 fpm.
- C. Medium Pressure: Greater than 2 inch WG to 6 inch WG and velocities greater than 1,500 fpm and less than 2,500 fpm.
- D. High Pressure: Greater than 6 inch WG to 12 inch WG and velocities greater than 2,500 fpm.
- E. FRP: Fiberglass-reinforced plastic.
- F. PVC: Polyvinyl Chloride.

1.4 SYSTEM DESCRIPTION

- A. Duct system design, as indicated, has been used to select size and type of air-moving and -distribution equipment and other air system components. Changes to layout or configuration of duct system must be specifically approved in writing by Architect. Accompany requests for layout modifications with calculations showing that proposed layout will provide original design results without increasing system total pressure.

1.5 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Application Schedule" Article.

1.6 ACTION SUBMITTALS

- A. Shop Drawings: Drawn to scale. Show fabrication and installation details for metal ducts. Shop drawings shall be reviewed and approved by the Architect prior to any fabrication.
 - 1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
 - 2. Duct layout indicating sizes and pressure classes.
 - 3. Elevations of top and bottom of ducts.
 - 4. Dimensions of main duct runs from building grid lines.
 - 5. Fittings.

6. Reinforcement and spacing.
7. Seam and joint construction.
8. Penetrations through fire-rated and other partitions.
9. Equipment installation based on equipment being used on Project.
10. Duct accessories, including access doors and panels.
11. Hangers and supports, including methods for duct and building attachment, vibration isolation.

1.7 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 1. Ceiling suspension assembly members.
 2. Other systems installed in same space as ducts.
 3. Ceiling- and wall-mounting access doors and panels required to provide access to dampers and other operating devices.
 4. Ceiling-mounting items, including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

1.8 CLOSEOUT SUBMITTALS

- A. Field quality-control test reports.

1.9 QUALITY ASSURANCE

- A. NFPA Compliance:
 1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
 2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with NFPA 96, "Ventilation Control and Fire Protection of Commercial Cooking Operations," Ch. 3, "Duct System," for range hood ducts, unless otherwise indicated.
- C. Duct Liner Maximum Temperature Limits: Based on ASTM C 411 test procedures.

1.10 COORDINATION

- A. Sheet metal trades shall cooperate fully with the Laboratory Airflow Controls Trades and shall attend all field installation training sessions.
- B. Sheet metal trades shall cooperate fully with the Test and Balance Contractor and provide all miscellaneous caps and any other materials required for structural integrity and leakage testing of the complete duct system in whole or in part. Refer to Division 23 Section "Testing, Adjusting and Balancing."
 1. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
- C. Sheet metal trades shall participate in the above ceiling coordination program. Refer to Division 01 requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 SHEET METAL MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G90 coating designation.
- C. Carbon-Steel Sheets: ASTM A 366/A 366M, cold-rolled sheets; commercial quality; with oiled, matte finish for exposed ducts.
- D. Stainless Steel: ASTM A 480/A 480M, Type 316, and having a No. 2D finish for concealed ducts and No. 4 for exposed ducts.
- E. Aluminum Sheets: ASTM B 209, alloy 3003, temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- F. Reinforcement Shapes and Plates:
 - 1. Galvanized-steel reinforcement where installed on galvanized sheet metal ducts.
 - 2. Compatible materials for aluminum and stainless-steel ducts.
- G. Tie Rods:
 - 1. Galvanized Steel Duct: Galvanized steel, 3/8-inch minimum diameter.
 - 2. Ducts in Humid or Corrosive Atmospheres: Stainless steel, 1/4-inch diameter for lengths 36 inches or less; 3/8-inch diameter for lengths longer than 36 inches.

2.3 DUCT LINER

- A. Flexible Elastomeric Duct Liner: Comply with NFPA 90A or NFPA 90B.
 - 1. Manufacturers:
 - a. Armacell LLC; AP Armaflex.
 - b. RBX Corporation; Insul-Sheet 1800.
 - 2. Materials: Flexible elastomeric, closed-cell, sponge-or expanded-rubber material, preformed sheet insulation complying with ASTM C 534, Type II, Grade I.
 - a. Thickness: 1/2 inch.

- b. Thermal Conductivity (k-Value): 0.24 at 75 deg F mean temperature.
- c. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM C 411.
- d. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.

2.4 SEALANTS AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Elastomeric Sealant Tape: 3 inches wide; modified butyl adhesive backed.
 1. Manufacturers:
 - a. Hardcast; Foil-Grip 1402 and Foil-Grip 1402-181BFX.
- C. Water-Based Joint and Seam Sealant:
 1. Manufacturers:
 - a. Design Polymerics; DP1010 Water Based Duct Sealant.
 - b. Hardcast; Flex-Grip 550 and Versa-Grip 181.
 - c. Polymer Adhesives; No. 11.
 - d. United McGill.
 2. Application Method: Brush on.
 3. Solids Content: Minimum 63 percent.
 4. Shore A Hardness: Minimum 20.
 5. Water resistant.
 6. Mold and mildew resistant.
 7. VOC: Maximum 75 g/L (less water).
 8. Maximum Static-Pressure Class: 0-inch wg, positive and negative.
 9. Service: Indoor or outdoor.
 10. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- D. Flanged Joint Sealant: Comply with ASTM C 920.
 1. General: Single-component, acid-curing, silicone, elastomeric.
 2. Type: S.
 3. Grade: NS.
 4. Class: 25.
 5. Use: O.
- E. Gaskets: Chloroprene elastomer, 40 durometer, 1/8 inch thick, full face, one piece vulcanized or dovetailed at joints.

2.5 HANGERS AND SUPPORTS

- A. Building Attachments: Concrete inserts, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
- B. Hanger Materials: Galvanized sheet steel or threaded steel rod.

1. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
 2. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
 3. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."
 4. Galvanized-steel straps attached to aluminum ducts shall have contact surfaces painted with zinc-chromate primer.
- C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials. Attachments for stainless steel and PVC-coated duct shall be stainless steel.
- D. Trapeze and Riser Supports: Steel shapes complying with ASTM A 36/A 36M.
1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
 2. Supports for Stainless-Steel Ducts: Stainless-steel support materials.
 3. Supports for Aluminum Ducts: Aluminum support materials unless materials are electrolytically separated from ducts.
- E. Load Rated Cable Suspension System for Noncorrosive Environments: Tested to five times the Safe Working Loads and verified by the SMACNA Testing and Research Institute.
1. Cable: Aircraft quality 7 x 7 and 7 x 19 wire rope.
 - a. Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
 - b. Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
 2. Fastener: One-piece, die-cast zinc housing with Type 302 S26 stainless steel hardened and tempered springs, and oil impregnated, sintered, hardened and tempered steel locking wedges.
 3. End Fixings: Loop, stud or toggle; or plain end suitable for wire rope beam clamp.
 4. Manufacturers:
 - a. B-Line by Eaton; KwikWire.
 - b. Ductmate Industries, Inc.; Clutcher and EZ-Lock.
 - c. Duro Dyne Corp.; Dyna-Tite System.
 - d. Gripple Inc.; Hang-Fast System.
- F. Stainless Steel Load Rated Cable Suspension System for Corrosive Environments: Tested to five times the Safe Working Loads and verified by the SMACNA Testing and Research Institute.
1. Cable: Aircraft quality stainless steel 7 x 7 and 7 x 19 wire rope.
 - a. Stainless steel complying with ASTM A 492.
 2. Fastener: One-piece, stainless steel housing with Type 302 S26 stainless steel hardened and tempered springs, and ceramic locking wedges.
 3. End Fixings:
 - a. Loop End: Type 316L/A4 stainless steel.
 - b. Stud or Toggle End: Type 304L/A2 stainless steel.

- c. Plain end suitable for stainless steel wire rope beam clamp.
- 4. Manufacturers:
 - a. B-Line by Eaton; KwikWire.
 - b. Ductmate Industries, Inc.; Clutcher and EZ-Lock.
 - c. Duro Dyne Corp.; Dyna-Tite System.
 - d. Gripple Inc.; Hang-Fast System.
- G. Welded Supports: Structural steel shapes with zinc rich paint. Equivalent, proprietary design, rolled steel structural support systems may be used in lieu of mill rolled structural steel.

2.6 ROOF MOUNTED DUCT SUPPORTS

- A. General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted duct.
- B. Support: Assembly of bases, and vertical and horizontal members, for roof installation without membrane penetration.
 - 1. Manufacturer:
 - a. B-Line by Eaton.
 - b. Eco Support Products.
 - c. MIFAB, Inc.; C-Port.
 - d. MIRO Industries.
 - e. Pentair Electrical & Fastening Solutions; CADDY.
 - f. Portable Pipe Hangers.
 - 2. Bases: Two or more plastic, stainless steel, or recycled rubber.
 - 3. Vertical Members: Two or more protective-coated-steel channels.
 - 4. Horizontal Member: Protective-coated-steel channel.

2.7 RECTANGULAR DUCT FABRICATION

- A. Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" unless otherwise indicated. For metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals, comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible", unless otherwise indicated.
 - 1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure class.
 - 2. Deflection: Duct systems shall not exceed deflection limits according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
 - 3. Internal Tie Rods: As allowed by SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
- B. Transverse Joints: Prefabricated slide-on joints and components constructed using manufacturer's and SMACNA guidelines for material thickness, reinforcement size and spacing, and joint reinforcement.
 - 1. Manufacturers:

- a. Ductmate Industries, Inc.
 - b. Nexus Inc.
- C. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches and larger and 0.0359 inch thick or less, with more than 10 sq. ft. of nonbraced panel area unless ducts are lined.

2.8 APPLICATION OF LINER IN RECTANGULAR DUCTS

- A. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
- B. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
- C. Butt transverse joints without gaps and coat joint with adhesive.
- D. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
- E. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and standard liner product dimensions make longitudinal joints necessary.
- F. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm or greater.
- G. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
- H. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
 - 1. Fan discharges.
 - 2. Intervals of lined duct preceding unlined duct.
 - 3. Upstream edges of transverse joints in ducts where air velocities are greater than 2500 fpm or where indicated.
- I. Where double-wall rectangular duct is indicated:
 - 1. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.
 - a. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.
 - 2. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.9 ROUND AND FLAT-OVAL DUCT AND FITTING FABRICATION

- A. Diameter as applied to flat-oval ducts in this Article is the diameter of a round duct with a circumference equal to the perimeter of a given size of flat-oval duct.
- B. Round, Spiral Lock-Seam Ducts: Fabricate supply ducts of galvanized steel according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" or SMACNA "Industrial Duct Construction Standards" as required based on pressure class.
 - 1. Round fittings shall be factory fabricated welded design. Use of field fabricated fittings (welded design) shall only be permitted when factory fabricated fittings are unavailable.
- C. Flat-Oval, Spiral Lock-Seam Ducts: Fabricate supply ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" or SMACNA "Industrial Duct Construction Standards" as required based on pressure class.
 - 1. Flat-oval fittings shall be factory fabricated welded design. Use of field fabricated fittings (welded design) shall only be permitted when factory fabricated fittings are unavailable.
- D. Duct Joints:
 - 1. Ducts up to 20 Inches in Diameter: Interior, center-beaded slip coupling, sealed before and after fastening, attached with sheet metal screws.
 - 2. Ducts 21 to 72 Inches in Diameter: Three-piece, gasketed, flanged joint consisting of two internal flanges with sealant and one external closure band with gasket.
 - 3. Ducts Larger Than 72 Inches in Diameter: Companion angle flanged joints per SMACNA "HVAC Duct Construction Standards--Metal and Flexible," Figure 3-2.
 - 4. Bolts and fasteners for galvanized steel duct shall be carbon steel, zinc coated per ASTM A153. Bolts and fasteners for stainless steel and polyvinyl chloride coated steel duct shall be stainless steel.
 - 5. Round Ducts: Prefabricated connection system consisting of double-lipped, EPDM rubber gasket. Manufacture ducts according to connection system manufacturer's tolerances.
 - 6. Flat-Oval Ducts: Prefabricated connection system consisting of two flanges and one synthetic rubber gasket.
- E. Low Pressure Ductwork (plus or minus 2 inches W.G. Static Pressure Class)
 - 1. Fabricate according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" unless otherwise indicated.
- F. Medium and High Pressure Ductwork (For Static Pressure Class Greater than plus or minus 2 inches W.G.)
 - 1. Geometry of fittings shall be according to SMACNA's HVAC Duct Construction Standards--Metal and Flexible unless otherwise indicated.
 - 2. Fittings shall be continuously welded, and shall be two gauges heavier than duct gauges indicated in SMACNA Standard. Joints shall be minimum 4 inch cemented slip joint, brazed or electric welded. Prime coat welded joints.
 - 3. Provide standard 45 degree lateral wye takeoffs unless otherwise indicated where 90 degree conical tee connections may be used.
- G. 90-Degree Tees and Laterals and Conical Tees: Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," with metal thicknesses specified for longitudinal-seam straight ducts.

- H. Diverging-Branch Flow Fittings: Fabricate with reduced entrance to branch taps and with no excess material projecting from fitting onto branch tap entrance.
- I. Fabricate elbows using die-formed, gored, pleated, or mitered construction. Unless elbow construction type is indicated, fabricate elbows as follows:
 - 1. Mitered-Elbow Radius and Number of Pieces: Welded construction complying with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.
 - 2. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from minus 2- to plus 2-inch wg:
 - a. Ducts 3 to 36 Inches in Diameter: 0.034 inch.
 - b. Ducts 37 to 50 Inches in Diameter: 0.040 inch.
 - c. Ducts 52 to 60 Inches in Diameter: 0.052 inch.
 - d. Ducts 62 to 84 Inches in Diameter: 0.064 inch.
 - 3. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from 2- to 10-inch wg:
 - a. Ducts 3 to 26 Inches in Diameter: 0.034 inch.
 - b. Ducts 27 to 50 Inches in Diameter: 0.040 inch.
 - c. Ducts 52 to 60 Inches in Diameter: 0.052 inch.
 - d. Ducts 62 to 84 Inches in Diameter: 0.064 inch.
 - 4. Flat-Oval Mitered Elbows: Welded construction with same metal thickness as longitudinal-seam flat-oval duct.
 - 5. 90-Degree, 2-Piece, Mitered Elbows: Use only for supply systems or for material-handling Class A or B exhaust systems and only where space restrictions do not permit using radius elbows. Fabricate with single-thickness turning vanes.
 - 6. Round Elbows 8 Inches and Less in Diameter: Fabricate die-formed elbows for 45- and 90-degree elbows and pleated elbows for 30, 45, 60, and 90 degrees only. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
 - 7. Round Elbows 9 through 14 Inches in Diameter: Fabricate gored or pleated elbows for 30, 45, 60, and 90 degrees unless space restrictions require mitered elbows. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
 - 8. Round Elbows Larger Than 14 Inches in Diameter and All Flat-Oval Elbows: Fabricate gored elbows unless space restrictions require mitered elbows.
 - 9. Die-Formed Elbows for Sizes through 8 Inches in Diameter and All Pressures 0.040 inch thick with 2-piece welded construction.
 - 10. Round Gored-Elbow Metal Thickness: Same as non-elbow fittings specified above.
 - 11. Flat-Oval Elbow Metal Thickness: Same as longitudinal-seam flat-oval duct specified above.
 - 12. Pleated Elbows for Sizes through 14 Inches in Diameter and Pressures through 10-Inch wg: 0.022 inch.
- J. PVC-Coated Elbows and Fittings: Fabricate elbows and fittings as follows:
 - 1. Round Elbows 4 to 8 Inches in Diameter: Two piece, die stamped, with longitudinal seams spot welded, bonded, and painted with PVC aerosol spray.
 - 2. Round Elbows 9 to 26 Inches in Diameter: Standing-seam construction.
 - 3. Round Elbows 28 to 60 Inches in Diameter: Standard gored construction, riveted and bonded.
 - 4. Other Fittings: Riveted and bonded joints.
 - 5. Couplings: Slip-joint construction with a minimum 2-inch insertion length.

PART 3 - EXECUTION

3.1 DUCTWORK APPLICATION SCHEDULE

- A. Ductwork materials and performance requirements are scheduled on the Drawing.

3.2 DUCT INSTALLATION

- A. Install ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.
- B. Install round and flat-oval ducts in lengths not less than 12 feet unless interrupted by fittings.
- C. Install ducts with fewest possible joints.
- D. Install fabricated fittings for changes in directions, size, and shape and for connections.
- E. Install couplings tight to duct wall surface with a minimum of projections into duct. Secure couplings with sheet metal screws. Install screws at intervals of 12 inches, with a minimum of 3 screws in each coupling.
- F. Install ducts, unless otherwise indicated, vertically and horizontally and parallel and perpendicular to building lines; avoid diagonal runs.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- I. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions unless specifically indicated.
- J. Coordinate layout with suspended ceiling, fire- and smoke-control dampers, lighting layouts, and similar finished work.
- K. Seal all joints and seams. Apply sealant to male end connectors before insertion, and afterward to cover entire joint and sheet metal screws.
- L. Electrical Equipment Spaces: Route ducts to avoid passing through transformer vaults and electrical equipment spaces and enclosures.
- M. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls and are exposed to view, conceal spaces between construction openings and ducts or duct insulation with sheet metal flanges of same metal thickness as ducts. Overlap openings on 4 sides by at least 1-1/2 inches.
- N. Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire dampers, and sleeves. Fire and smoke dampers are specified in Division 23 Section "Duct Accessories."
 - 1. Where ducts not having fire dampers, smoke dampers, or combination fire and smoke dampers pass through fire-rated partitions, maintain indicated fire rating. Seal penetrations with firestop materials. Refer to Division 07 Specification Sections for materials and UL classified firestop systems.

- O. Protect duct interiors from moisture, construction debris and dust, and other foreign materials.
- P. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."
 - 1. Intermediate level.

3.3 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.4 UNDERSLAB DUCTS, SPECIAL INSTALLATION REQUIREMENTS

- A. Verify undamaged condition of ducts before enclosure with fill or encasement.
- B. Protect ducts from damage by equipment used in placing fill materials and concrete on or around ducts.
- C. Protect duct openings from damage and prevent entrance of foreign materials.

3.5 EQUIPMENT INSTALLATION

- A. Install venturi terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance. Refer to details for additional requirements.

3.6 DUCT SEALING

- A. Seal duct seams and joints according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for duct pressure class indicated. Ducts must be properly cleaned and sealed in strict accordance with sealant manufacturer's instructions.
 - 1. Seal Class: Refer to Application Schedule on the Drawings.
 - 2. Seal ducts before external insulation is applied.
 - 3. After pressure testing, remake leaking joints until leakage is equal to or less than maximum allowable. Refer to Application Schedule on the Drawings for allowable leakage rates.

3.7 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- C. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- D. Install concrete inserts before placing concrete.
- E. Support ductwork from building structure, not from roof deck, floor slab, pipe, other ducts, or equipment.
- F. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.
- G. Install roof mounted duct supports in accordance with manufacturer's instructions. Provide additional membrane layer or walkpads under support bases as required.
- H. Use load rated cable suspension system for round duct in exposed locations.

3.8 CONNECTIONS

- A. Make connections to equipment with flexible connectors according to Division 23 Section "Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.9 PAINTING

- A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 09 painting Sections.

3.10 FIELD QUALITY CONTROL

- A. Duct System Cleanliness Tests:
 - 1. Visually inspect duct system to ensure that no visible contaminants are present.
- B. Duct system will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.11 START UP

- A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing."

END OF SECTION 233113

SECTION 233116 - NONMETAL DUCTS

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 23 Section "Duct Accessories" for dampers, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.2 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including duct closure, reinforcements, and hangers and supports, shall comply with SMACNA's "Fibrous Glass Duct Construction Standards" and performance requirements and design criteria indicated.
 - 1. Static-Pressure Classes:
 - a. Supply Ducts (except in Mechanical Rooms): 1-inch wg.
 - b. Supply Ducts (Upstream from Air Terminal Units): 2-inch wg.
 - c. Supply Ducts (Downstream from Air Terminal Units): 1-inch wg.
 - d. Supply Ducts (in Mechanical Equipment Rooms): 2-inch wg.
 - e. Return Ducts (Negative Pressure): 1-inch wg.
 - f. Exhaust Ducts (Negative Pressure): 1-inch wg.

1.3 DEFINITIONS

1. Example: Apparent Thermal Conductivity (k-Value): 0.26.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

1. Fibrous-glass duct materials.
2. Thermoset FRP duct materials.
3. Thermoplastic duct (PVC) materials.
4. Concrete ducts.
5. Fabric ducts.

1.5 INFORMATIONAL SUBMITTALS

1. Including plans, elevations, sections, components, and attachments Drawn to 1/4 inch equals 1 foot scale. Show fabrication and installation details for nonmetal ducts.
2. Fabrication, assembly, and installation to other work.
3. Duct layout indicating sizes and pressure classes.
4. Elevations of top and bottom of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcements and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Duct accessories, including access doors and panels.
12. Hangers and supports, including methods for duct and building attachment, vibration isolation.

B. Delegated-Design Submittal:

1. Duct materials and thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Design Calculations: Calculations for selecting hangers and supports.

C. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Ceiling suspension assembly members.
2. Other systems installed in same space as ducts.
3. Ceiling- and wall-mounting access doors and panels required to provide access to dampers and other operating devices.
4. Ceiling-mounting items, including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

D. Welding certificates.

1.6 CLOSEOUT SUBMITTALS

- A. Field quality-control reports.

1.7 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
- B. NFPA Compliance:
1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
 2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- C. UL Compliance: UL listed and labeled as complying with UL 181.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 HDPE UNDERGROUND DUCTS

- A. Manufacturers:
1. AQC Industries; Blue Duct.
 2. Simtech Process Systems.
- B. Description: Complete duct system (including: plenums, round duct, run-outs, diffuser boots, etc.) must be from one manufacturer and be of the same material, construction and connection method throughout. Field made duct components are not acceptable.
- C. Construct duct and fittings in accordance with SMACNA's Duct Construction Standards.
- D. Furnish elbows, duct, diffusers, plenum, clamp and gasket, boots, saddle registers and caulk as required by drawings for underground installation.
- E. Material: Ductwork shall be closed cell plastic material that is recyclable, does not emit volatile organic compounds, and conforms to ASTM-D2412.
1. Ductwork shall be resistant to mildew, mold (UL 181B), and radon gas (BSS 7239-88).
 2. Ductwork shall not rust or crack under external stress or strain.

3. Ductwork shall have integral R-10 equivalent thermal insulation value, without the use of external insulation, in accordance with NSF's P374 Protocol and verified by NSF Thermal Testing Report.

F. Joints: Joints shall be sealed via gasket or bolts and sealant.

1. Clamps and gaskets shall be used on ductwork without flanges.
2. Clamps shall be polyethylene with stainless steel plates and stainless steel screws.
3. Gaskets shall comprise of 1/4-inch thick butyl rubber sealant tape that is water and UV resistant and shall not stain.
4. Gaskets shall comply with ASTM-E84 for flame and smoke spread.
5. Flanged Joints: Flanged joints and duct branches shall use manufacturer's standard co-polymer adhesive caulking sealant that is water and UV resistant. Flanges shall be connected with stainless steel bolts.

G. Assembled ductwork shall be able to maintain pressure with no leakage.

H. Duct system performance shall exceed SMACNA's Leakage Class 3 requirements at the system design static pressure.

2.3 HANGERS AND SUPPORTS

A. Building Attachments: Concrete inserts, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

B. Hanger Materials: Galvanized sheet steel or threaded steel rod.

1. Hangers Installed in Corrosive Atmospheres: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
2. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for steel sheet width and thickness and for steel rod diameters.
3. Galvanized-steel straps attached to aluminum ducts shall have contact surfaces painted with zinc-chromate primer.

C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials. Attachments for stainless steel and PVC-coated duct shall be stainless steel.

D. Trapeze and Riser Supports: Steel shapes complying with ASTM A 36/A 36M.

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Stainless-Steel Ducts: Stainless-steel support materials.
3. Supports for Aluminum Ducts: Aluminum support materials unless materials are electrolytically separated from ducts.

E. Load Rated Cable Suspension System: Tested to five times the Safe Working Loads and verified by the SMACNA Testing and Research Institute.

1. Cable: Aircraft quality zinc coated 7 x 7 and 7 x 19 wire rope.
2. Fastener: One-piece, die-cast zinc housing with Type 302 S26 stainless steel hardened and tempered springs, and oil impregnated, sintered, hardened and tempered steel locking wedges.
3. End Fixings: Loop, stud or toggle; or plain end suitable for wire rope beam clamp.
4. Manufacturers:

- a. Ductmate Industries, Inc.; Clutcher and EZ-Lock.
 - b. Duro Dyne Corp.; Dyna-Tite System.
 - c. Gripple Inc.; Hang-Fast System.
- F. Welded Supports: Structural steel shapes with zinc rich paint. Equivalent, proprietary design, rolled steel structural support systems may be used in lieu of mill rolled structural steel.

PART 3 - EXECUTION

3.1 EXCAVATION

- A. Refer to Division 31 Section "Earthwork" for excavating, trenching, and backfilling.

3.2 APPLICATION AND INSTALLATION

- A. Install nonmetal duct where indicated and as detailed on Drawings.
- B. Install ducts with fewest possible joints.
- C. Install ducts, unless otherwise indicated, vertically and horizontally and parallel and perpendicular to building lines; avoid diagonal runs.
- D. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- E. Install ducts with a clearance of 1 inch.
- F. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions unless specifically indicated.
- G. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls and are exposed to view, conceal spaces between construction openings and ducts with sheet metal flanges. Overlap opening on 4 sides by at least 1-1/2 inches.
- H. Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire dampers and sleeves. Fire and smoke dampers are specified in Division 23 Section "Duct Accessories."
- I. Install fibrous-glass ducts and fittings according to
- J. Install thermoplastic ducts (PVC) and fittings according to SMACNA's "Thermoplastic Duct (PVC) Construction Manual."
- K. Install thermoset FRP ducts and fittings according to NFPA 91.

3.3 UNDERSLAB DUCTS, SPECIAL INSTALLATION REQUIREMENTS

- A. Verify undamaged condition of ducts before enclosure with fill or encasement.
- B. Protect ducts from damage by equipment used in placing fill materials and concrete on or around ducts.

- C. Protect duct openings from damage and prevent entrance of foreign materials.

3.4 HDPE UNDERGROUND DUCTS

- A. Duct system shall be installed by manufacturer trained installers.

3.5 HANGER AND SUPPORT INSTALLATION

- A. Install hangers and supports for fibrous-glass ducts and fittings to comply with
- B. Install hangers and supports for phenolic-foam ducts and fittings to comply with Knauf Insulation's "Knauf KoolDuct System Design Guide," Section 5, "Ductwork System General."
- C. Duct Attachments: Support horizontal ducts with trapeze-type hangers.
- D. Attach hangers to joints and reinforcing channels that occur within required hanger spacing. Attach hangers to transmit load to sides and bottom channels and no more than 6 inches from sides of ducts.
- E. Support equipment and metal duct components and accessories independent of ducts.
- F. Support terminal components separately.
- G. Install sheet metal sleeves to support dampers. For motorized dampers, extend sleeves to support operators.
- H. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Inspect fibrous-glass duct systems according to "Inspection Checklist for Fibrous Glass Duct System Installation" in NAIMA AH116. Prepare a written report using the format of this checklist.
- C. Duct System Cleanliness Tests:
 - 1. Visually inspect duct system to ensure that no visible contaminants are present.
- D. Duct system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.7 START UP

- A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing."

END OF SECTION 233116

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 23 Section "Testing, Adjusting, and Balancing" for duct test holes.
 - 3. Division 23 Section "Temperature Controls" for motorized control dampers.
 - 4. Division 28 Section "Fire Alarm" for duct-mounting fire and smoke detectors.

1.2 DEFINITIONS

- A. NVLAP: National Voluntary Laboratory Accreditation Program.
- B. Low Pressure: Up to 2 inch WG and velocities less than 1,500 fpm. Construct for 2 inch WG positive or negative static pressure.

- C. Medium Pressure: Greater than 2 inch WG to 6 inch WG and velocities greater than 1,500 fpm and less than 2,500 fpm. Construct for 6 inch WG positive or negative static pressure.
- D. High Pressure: Greater than 6 inch WG to 12 inch WG and velocities greater than 2,500 fpm. Construct for 12 inch WG positive or negative static pressure.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. For turning vanes, include data for pressure loss generated sound power levels.
 - 2. For duct silencers, include pressure drop and dynamic insertion loss data.

1.4 INFORMATIONAL SUBMITTALS

- A. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.
 - 1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
 - a. Special fittings.
 - b. Manual volume damper installations.
 - c. Control damper installations.
 - d. Fire-damper, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
 - e. Duct security bars.
- B. Coordination Drawings: Reflected ceiling plans, drawn to scale and coordinating penetrations and ceiling-mounting items. Show ceiling-mounting access panels and access doors required for access to duct accessories.
- C. Source quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with AMCA 500-D testing for damper rating.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fusible Links: Furnish quantity equal to 10 percent of amount installed for each temperature rating.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 SHEET METAL MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated.
- B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G90 coating designation.
- C. Stainless Steel: ASTM A 480/A 480M, Types 304 and 316 as indicated.
- D. Extruded Aluminum: ASTM B 221, alloy 6063, temper T6.
- E. Bird Screens: No. 2 mesh, 0.063 inch diameter galvanized wire screen with open area of not less than 72 percent. Conceal sharp edges by adding metal edging consisting of rod, flat or angle iron, or 16 gage galvanized sheet steel turned over at least 3/4 inch on both sides.

2.3 BACKDRAFT DAMPERS

- A. Manufacturers:
 - 1. American Warming and Ventilating; Mestek, Inc.
 - 2. Greenheck Fan Corporation.
 - 3. Ruskin Company.
- B. Description: Multiple-blade, parallel action counterbalanced, with blades of maximum 6-inch width, with sealed edges, assembled in rattle-free manner with 90-degree stop, steel ball bearings, and axles; adjustment device to permit setting for varying differential static pressure.
- C. Performance: Based on tests in accordance with AMCA Standard 500:
 - 1. Pressure drop not to exceed 0.15 inch wg at face velocity of 2500 fpm.

2. Leakage not to exceed 9.2 cfm per square foot at 1 inch wg differential and temperature of 70 deg F .
 - D. Frame: 0.052-inch- thick, galvanized sheet steel or 0.063-inch- thick extruded aluminum, with welded corners and mounting flange.
 - E. Blades: 0.025-inch- thick, roll-formed aluminum or 0.050-inch- thick aluminum sheet.
 - F. Blade Seals: Manufacturer's standard seal material.
 - G. Blade Axles: Nonferrous or galvanized steel.
 - H. Tie Bars and Brackets: Aluminum or galvanized steel.
- 2.4 LOW PRESSURE MANUAL VOLUME DAMPERS
- A. Manufacturers:
 1. American Warming and Ventilating; Mestek, Inc.
 2. Arrow United Industries; Mestek, Inc.
 3. Greenheck Fan Corporation.
 4. Krueger-HVAC; Air Distribution Technologies, Inc.; a JCI Company.
 5. Louvers and Dampers, Inc.; Mestek, Inc.
 6. Nailor Industries Inc.
 7. Pottorff.
 8. Ruskin Company.
 9. Vent Products Co., Inc.
 10. Young Regulator Co.
 - B. General Description: Factory fabricated, with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.
 1. Except for dampers in round ductwork sized 12 inches and smaller, provide end bearings.
 - C. Rectangular Volume Dampers: Multiple-opposed-blade design, AMCA certified for maximum leakage of 2 percent of total fan volume at shutoff, and suitable for horizontal or vertical applications.
 - D. Round Volume Dampers 16-inch Diameter and Smaller: Single-blade design, AMCA certified for maximum leakage of 2 percent of total fan volume at shutoff, and suitable for horizontal or vertical applications.
 - E. Round Volume Dampers Larger than 16-inch Diameter: Multiple-opposed-blade design AMCA certified for maximum leakage of 2 percent of total fan volume at shutoff, and suitable for horizontal or vertical applications.
 - F. Damper Materials:
 1. Steel Frames: Hat-shaped, galvanized sheet steel channels, minimum of 0.064 inch thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.
 2. Roll-Formed Steel Blades: 0.064-inch- thick, galvanized sheet steel.

3. Blade Axles: Galvanized steel.
 4. Bearings: Oil-impregnated bronze, molded synthetic, or stainless-steel sleeve type.
 5. Tie Bars and Brackets: Galvanized steel.
- G. Jackshaft: 1-inch- diameter, galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
1. Length and Number of Mountings: Appropriate to connect linkage of each damper in multiple-damper assembly.
- H. Damper Hardware: Zinc-plated, die-cast core with dial and handle made of 3/32-inch-thick zinc-plated steel, and a 3/4-inch hexagon locking nut. Include center hole to suit damper operating-rod size. Include elevated platform for insulated duct mounting.
- I. Positive-Locking Damper Hardware:
1. Manufacturers:
 - a. Duro Dyne Corporation; Dyna-Click.
 - b. Rossi Hardware; Everlock.
 - c. Windgate Products Co., Inc.; Sure-Loc & Sure-Loc HD.
 2. Quadrant Material: 18 gage galvanized steel aluminum with 11 to 15 locking positions.
 3. Handle material: Die-cast aluminum or flame-retardant high-strength polymer.
 4. Include center hole to suit damper operating-rod size.
 5. Include elevated platform for insulated duct mounting on either round or rectangular duct.

2.5 MEDIUM OR HIGH PRESSURE MANUAL VOLUME DAMPERS

- A. Manufacturers:
1. American Warming and Ventilating; Mestek, Inc.
 2. Greenheck Fan Corporation.
 3. Louvers and Dampers, Inc.; Mestek, Inc.
 4. Nailor Industries Inc.
 5. Pottorff.
 6. Ruskin Company.
 7. Vent Products Co., Inc.
- B. General Description: Factory fabricated, galvanized steel or extruded aluminum construction, with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.
- C. Rectangular Volume Dampers: Multiple-opposed-blade design, AMCA certified for maximum leakage of 2 percent of total fan volume at shutoff, and suitable for horizontal or vertical applications. Construction and assembly such that no noise producing blade vibration occurs at velocities 20 percent greater than maximum system design velocity.
- D. Round Volume Dampers 16-inch Diameter and Smaller: Single-blade, or multiple-opposed-blade design, AMCA certified for maximum leakage of 2 percent of total fan

volume at shutoff, and suitable for horizontal or vertical applications. Construction and assembly such that no noise producing blade vibration occurs at velocities 20 percent greater than maximum system design velocity.

- E. Round Volume Dampers Larger than 16-inch Diameter: Multiple-opposed-blade design, AMCA certified for maximum leakage of 2 percent of total fan volume at shutoff, and suitable for horizontal or vertical applications. Construction and assembly such that no noise producing blade vibration occurs at velocities 20 percent greater than maximum system design velocity.
- F. Damper Materials:
 - 1. Steel Frames: Hat-shaped, galvanized sheet steel channels, minimum of 0.064 inch thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.
 - 2. Roll-Formed Steel Blades: 0.064-inch- thick, galvanized sheet steel.
 - 3. Aluminum Frames: Hat-shaped, 0.10-inch- thick, aluminum sheet channels; frames with flanges where indicated for attaching to walls; and flangeless frames where indicated for installing in ducts.
 - 4. Extruded-Aluminum Blades: 0.050-inch- thick extruded aluminum.
 - 5. Blade Axles: Galvanized steel or stainless steel.
 - 6. Bearings: Oil-impregnated bronze, molded synthetic, or stainless-steel sleeve type.
 - 7. Tie Bars and Brackets: Aluminum or galvanized steel.
- G. Jackshaft: 1-inch- diameter, galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
 - 1. Length and Number of Mountings: Appropriate to connect linkage of each damper in multiple-damper assembly.
- H. Damper Hardware: Zinc-plated, die-cast core with dial and handle made of 3/32-inch-thick zinc-plated steel, and a ¼-inch hexagon locking nut. Include center hole to suit damper operating-rod size. Include elevated platform for insulated duct mounting.
- I. Positive-Locking Damper Hardware:
 - 1. Manufacturers:
 - a. Duro Dyne Corporation; Dyna-Click.
 - b. Rossi Hardware; Everlock.
 - c. Windgate Products Co., Inc.; Sure-Loc & Sure-Loc HD.
 - 2. Quadrant Material: 18 gage galvanized steel aluminum with 11 to 15 locking positions.
 - 3. Handle material: Die-cast aluminum or flame-retardant high-strength polymer.
 - 4. Include center hole to suit damper operating-rod size.
 - 5. Include elevated platform for insulated duct mounting on either round or rectangular duct.

2.6 MOTORIZED CONTROL DAMPERS

- A. Refer to Division 23 Section "Temperature Controls."

2.7 FIRE DAMPERS (CURTAIN STYLE)

A. Manufacturers:

1. Air Balance, Inc.; Mestek, Inc
2. Greenheck Fan Corporation.
3. NCA; a brand of Metal Industries Inc.
4. Nailor Industries Inc.
5. Pottorff.
6. Ruskin Company.

B. Dynamic fire dampers with curtain style blades, and labeled according to UL 555, maximum velocity 2000 fpm, maximum static pressure 4 inches w.g.

C. Fire Rating:

1. 1-1/2 hours for 2 hour rated walls.
2. 3 hours for 4 hour rated walls.

D. Frame: Type B or Type C Curtain type with blades outside airstream; fabricated with roll-formed, galvanized steel in gages required by manufacturer's UL listing; with mitered and interlocking corners.

E. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.

1. Thickness: Equal to or thicker than the duct connected to it, and of length to suit application.
2. Exceptions: Omit sleeve where damper frame width permits direct attachment of perimeter mounting angles on each side of wall or floor, and thickness of damper frame complies with sleeve requirements.

F. Mounting Orientation: Vertical or horizontal as indicated.

G. Blades: Roll-formed, interlocking, 0.034-inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- thick, galvanized-steel blade connectors.

H. Fusible Links: Replaceable, 212 deg F rated.

2.8 FIRE DAMPERS (MULTIPLE BLADE TYPE)

A. Manufacturers:

1. Greenheck Fan Corporation.
2. NCA; a brand of Metal Industries Inc.
3. Nailor Industries Inc.
4. Pottorff.
5. Ruskin Company.

B. Dynamic fire dampers with multiple blades, and labeled according to UL 555, maximum velocity of 2000 fpm, maximum static pressure 4 inches w.g.

C. Fire Rating:

1. 1-1/2 hours for 2 hour rated walls.
2. 3 hours for 4 hour rated walls.

- D. Frame: Fabricated with roll-formed, galvanized steel in gages required by manufacturer's UL listing; with mitered and interlocking corners.
- E. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
 - 1. Thickness: Equal to or thicker than the duct connected to it, and of length to suit application.
 - 2. Exceptions: Omit sleeve where damper frame width permits direct attachment of perimeter mounting angles on each side of wall or floor, and thickness of damper frame complies with sleeve requirements.
- F. Mounting Orientation: Vertical or horizontal as indicated.
- G. Blades: Parallel operation, single-piece airfoil type construction with 0.078 inch equivalent thickness, or 0.064 inch thick, roll-formed, triple v-groove.
- H. Axles: 1/2 inch plated steel hex.
- I. Bearings: Stainless steel, or oil-impregnated bronze sleeve type, pressed into frame.
- J. Linkage: Concealed in frame.
- K. Fusible Links: Replaceable, 212 deg F rated.

2.9 TURNING VANES

- A. Manufactured Turning Vanes:
 - 1. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for vanes and vane runners. Vane runners shall automatically align vanes.
 - 2. Double-vane or airfoil-shaped, curved blades of galvanized sheet steel set into vane runners suitable for duct mounting.
 - 3. Generated sound power level shall not exceed 54 decibels in octave band 4 at 2000 fpm in a 24-inch by 24-inch duct.
 - 4. Manufacturers:
 - a. Aero-Dyne Sound Control; H-E-P Turning Vanes & Rail.
 - b. Ductmate Industries, Inc.
 - c. Duro Dyne Corporation.
 - d. Ward Industries, Inc.; a JCI Company.
- B. Manufactured Acoustic Turning Vanes:
 - 1. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for vanes and vane runners. Vane runners shall automatically align vanes.
 - 2. Double-vane curved blades of galvanized sheet steel with perforated faces and fibrous-glass fill set into vane runners suitable for duct mounting.
 - 3. Manufacturers:
 - a. Ductmate Industries, Inc.
 - b. Ward Industries, Inc.; a JCI Company.

2.10 REMOTE DAMPER OPERATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Pottorff.
 - 2. Ventfabrics, Inc.
 - 3. Young Regulator Co.
- B. Description: Cable system designed for remote manual damper adjustment.
- C. Tubing: Brass.
- D. Cable: Stainless steel.
- E. Wall-Box Mounting: Recessed, 3/4 inches deep.
- F. Wall-Box Cover-Plate Material: Stainless steel.

2.11 DUCT-MOUNTING ACCESS DOORS

- A. General Description: Fabricate doors airtight and suitable for duct pressure class. Doors may be field fabricated in accordance with SMACNA Standards, or commercially produced.
- B. Door: Double wall, duct mounting, and rectangular; fabricated of galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class. Include vision panel where indicated. Include 1-by-1-inch butt or piano hinge and cam latches.
 - 1. Manufacturers:
 - a. Air Balance, Inc.; Mestek, Inc.
 - b. Greenheck Gan Corporation.
 - c. Nailor Industries Inc.
 - d. Ruskin Company.
 - 2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
 - 3. Provide number of hinges and locks as follows:
 - a. Less Than 12 Inches Square: Secure with two sash locks.
 - b. Up to 18 Inches Square: Two hinges and two compression locks.
 - c. Up to 24 by 48 Inches: Three hinges and two compression latches with outside and inside handles.
 - d. Sizes 24 by 48 Inches and Larger: One additional hinge.
- C. Door: Double wall, duct mounting, and round; fabricated of galvanized sheet metal with insulation fill and 1-inch thickness. Include cam latches.
 - 1. Manufacturers:
 - a. Ductmate Industries, Inc.
 - b. Flexmaster U.S.A.; a Masterduct Company.
 - 2. Frame: Galvanized sheet steel, with spin-in notched frame.

- D. Seal around frame attachment to duct and door to frame with neoprene or foam rubber.
- E. Insulation: 1-inch-thick, fibrous-glass or polystyrene-foam board.

2.12 FLEXIBLE CONNECTORS

- A. Manufacturers:
 - 1. ADSCO Manufacturing LLC.
 - 2. Duro Dyne Corp.
 - 3. Senior Flexonics Pathway.
 - 4. Ventfabrics, Inc.
- B. General Description: Flame-retardant or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.
- C. Metal-Edged Connectors: Factory fabricated with a fabric strip minimum 3-1/2 inches wide attached to two strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Select metal compatible with ducts.
- D. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
 - 1. Minimum Weight: 26 oz./sq. yd.
 - 2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
 - 3. Service Temperature: Minus 20 to plus 200 deg F.

2.13 FLEXIBLE DUCTS, LOW AND MEDIUM PRESSURE

- A. Manufacturers:
 - 1. Flexmaster U.S.A.; a Masterduct Company; Type 1M Acoustical.
 - 2. Hart & Cooley.
 - 3. Thermaflex; part of the Flexible Technologies Group.
- B. Flexible Ducts: Interlocking spiral of galvanized steel or aluminum construction or fabric supported by helically wound spring steel wire or flat steel bands; rated to 6 inches WG positive and 4 inches WG negative for low and medium pressure ducts.
- C. Insulated Flexible Ducts: UL 181, Class 1, flexible duct wrapped with flexible glass fiber insulation, enclosed by a fire retardant polyethylene vapor barrier jacket; maximum 0.23 K value at 75 deg F.
- D. Acoustical performance tested in accordance with the Air Diffusion Council's *Flexible Air Duct Test Code FD 72-R1, Section 3.0, Sound Properties* shall be as follows:

The insertion loss (dB) of a 10 foot length of straight duct when tested in accordance with ASTM E477, at a velocity of 2500 feet per minute, shall be minimum:

Octave Band	2	3	4	5	6	7
Hz.	125	250	500	1000	2000	4000
6" diameter	8	32	38	35	39	25
8" diameter	13	32	36	35	36	21
12" diameter	15	29	28	33	26	14

The radiated noise reduction (dB) of a 10 foot length of straight duct when tested in accordance with ASTM E477, at a velocity of 2500 feet per minute, shall be minimum:

Octave Band	2	3	4	5	6	7
Hz.	125	250	500	1000	2000	4000
6" diameter	6	8	7	8	9	13
8" diameter	9	6	6	7	8	10
12" diameter	9	7	6	6	8	11

The self-generated sound power levels (LW) dB are 10-12 Watt of a 10 foot length of straight duct for an empty sheet metal duct when tested in accordance with ASTM E477, at a velocity of 1000 feet per minute, shall not exceed:

Octave Band	2	3	4	5	6	7
Hz.	125	250	500	1000	2000	4000
6" diameter	42	31	23	18	17	21
8" diameter	41	34	27	19	18	21
12" diameter	53	44	36	27	21	22

- E. Flexible Duct Fittings: Galvanized steel, twist-in design with damper. Size as indicated.
- F. Flexible Duct Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action, in sizes 3 through 18 inches to suit duct size.

2.14 FLEXIBLE DUCT ELBOW SUPPORTS

- A. Manufacturer:
 1. Titus; Air Distribution Technologies, Inc.; a JCI Company; FlexRight.
 2. Thermaflex; part of the Flexible Technologies Group; FlexFlow Elbow.
 3. Hart and Cooley, Inc.; Smart Flow Elbow.
- B. Elbow supports shall be constructed of durable composite material and be fully adjustable to support flexible duct diameters 6 inches through 16 inches.
- C. Elbow supports shall be UL listed for use in return air plenum spaces.

2.15 DUCT ACCESSORY HARDWARE

- A. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

2.16 FINISHES

- A. Chemical Resistant Coating: P-403 manufactured by Heresite Chemical Company.

PART 3 - EXECUTION

3.1 APPLICATION AND INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Provide duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts and PVC coated ducts; and aluminum accessories in aluminum ducts.
- C. Install control dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
 - 1. Install steel volume dampers in steel ducts.
 - 2. Install stainless steel volume dampers in stainless steel ducts.
 - 3. Install aluminum volume dampers in aluminum ducts.
- E. Set dampers to fully open position before testing, adjusting, and balancing.
- F. Install fire dampers according to UL listing.
- G. Install duct silencers rigidly to ducts.
- H. Install duct access doors on ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
 - 1. On upstream side of duct coils.
 - 2. On downstream side of air duct coils.
 - 3. Upstream from duct filters.
 - 4. At outdoor-air intakes and mixed-air plenums.
 - 5. At drain pans.
 - 6. Downstream from control dampers, backdraft dampers, and duct mounted equipment.
 - 7. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links.
 - 8. Control devices requiring inspection, including airflow measuring devices. Size access doors appropriately to facilitate service of each device.
 - 9. Elsewhere as indicated.
- I. Install access doors with swing against duct static pressure.
- J. Install duct-mounting, rectangular access doors with long dimension at right angles to direction of airflow and of largest standard size which can be accommodated in duct. Maximum size: 21 by 14 inches.
- K. Install pressure relief doors vertically and level in accordance with manufacturer's instructions, between the fan and first operable damper.
- L. Label access doors according to Division 20 Section "Mechanical Identification."
- M. Install flexible connectors immediately adjacent to equipment in ducts associated with fans and motorized equipment supported by vibration isolators.

- N. For fans developing static pressures of 5-inch wg and higher, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- O. Connect terminal units to supply ducts directly or with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.
- P. Connect diffusers or light troffer boots to low pressure ducts flexible duct clamped or strapped in place.
- Q. Connect flexible ducts to metal ducts with plenum-rated draw bands.
- R. Install flexible duct elbow supports at each diffuser, grille, or register, and elsewhere as indicated.
- S. Install turning vanes in rectangular duct elbows in excess of 45 degrees, and where indicated:
 - 1. Use manufactured double-vane turning vanes unless otherwise specified.
 - 2. Seat outboard-most vane in heel of duct elbow.
 - 3. Provide vanes for all runner punchings. Practice of eliminating every other vane is prohibited.
 - 4. Use single-vane turning vanes in low pressure square elbows.

3.2 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Operate dampers to verify full range of movement.
 - 2. Inspect locations of access doors and verify that purpose of access door can be performed.
 - 3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
 - 4. Inspect turning vanes for proper and secure installation.
 - 5. Operate remote damper operators to verify full range of movement of operator and damper.

3.3 ADJUSTING

- A. Adjust duct accessories for proper settings.
- B. Adjust fire dampers, combination fire and smoke dampers, and smoke dampers for proper action.
- C. Final positioning of manual-volume dampers is specified in Division 23 Section "Testing, Adjusting, and Balancing."

END OF SECTION 233300

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Motors."
 - 3. Division 23 Section "Common Work Results for HVAC" for common mechanical drive requirements for fans and air moving equipment.

1.2 PERFORMANCE REQUIREMENTS

- A. AMCA Compliance:
 - 1. Operating Limits: Classify according to AMCA 99.

1.3 ACTION SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:
 - 1. Certified fan performance curves with system operating conditions indicated.
 - 2. Certified fan sound-power ratings.
 - 3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
 - 4. Material thickness.
 - 5. Dampers, including housings, linkages, and operators.

1.4 INFORMATIONAL SUBMITTALS

- A. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Wiring Diagrams: Power, signal, and control wiring.
 - 2. Design Calculations: Calculate requirements for selecting vibration isolators and for designing vibration isolation bases.
 - 3. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.

1.5 CLOSEOUT SUBMITTALS

- A. Field quality-control test reports.
- B. Operation and Maintenance Data: For fan arrays to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.
- B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver fans as factory-assembled units, to the extent allowable by shipping limitations, with protective crating and covering.
- B. Disassemble and reassemble units, as required for moving to the final location, according to manufacturer's written instructions.
- C. Lift and support units with manufacturer's designated lifting or supporting points.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fan Array: Fan/motor cartridge for emergency replacement, one for each type of assembly provided on the project.

PART 2 - PRODUCTS

2.1 FAN ARRAYS WITH ECM (TYPE 3)

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AHU manufacturer's typical OEM fan supplier.
- B. Description: Fan array shall consist of multiple, direct driven plenum fans. All fans shall be selected to deliver design air flow at the specified operating Total Static Pressure (TSP) at the specified motor speed and as scheduled. Fan array shall be selected to operate at a system TSP that does not exceed 90 percent of the specified fan's peak static pressure producing capability at the specified fan speed.
- C. Plenum fan(s) shall be provided and both axial and radial clearances must be equal to or greater than fan manufacturer's recommendations for full rated fan performance and efficiency.
- D. Fan housing or cell shall be constructed of aluminum or stainless steel with perforated inner liner, melamine insulation, with either solid or perforated outer panels as required by application.
- E. Fan/motor assembly shall be mounted within the housing on an adjustable slide rail base. Fan/motor assembly must be capable of either horizontal or vertical application.
- F. Assemblies shall be dynamically balanced to meet AMCA standard 204-96, for fan application class BV-4, to meet or exceed a rotational imbalance Grade G 2.5, producing a maximum rotational imbalance of 0.10 inches per second peak, filter in. "Filter in" measurement indicates that the specified balance grade must be achieved at the submitted design operating speed for the fan(s).
- G. Backdraft Prevention: Each individual cube or cell in the multiple fan arrays shall be provided with an integral backdraft damper or manually installed blank off plate that prohibits recirculation of air in the event a fan or multiple fans become disabled. All fans in the multiple fan arrays shall be provided with a back flow prevention means that produces near no static pressure drop and/or system effect when that fan is enabled. The system effects for the back flow prevention device(s) shall be included in the criteria for TSP determination for fan selection purposes, and shall be indicated as a separate line item SP loss in the submittals.
- H. Motors: ECM.
 - 1. Synchronous, constant torque, ECM with permanent magnet rotor. Rotor magnets to be time-stable, nontoxic ceramic magnets (Sr-Fe). Motors shall be permanently lubricated.
 - 2. Driven by a frequency converter with an integrated power factor correction filter. Conventional induction motors will not be acceptable.
 - 3. Each motor with an integrated speed controller, tested as one unit by manufacturer.
 - 4. Motor speed adjustable over full range from 0 rpm to maximum scheduled speed.
 - 5. Variable motor speed to be controlled by a 0- to 10 V-dc or 4- to 20-mA input.
 - 6. Integrated motor protection verified by UL to protect equipment against over-/undervoltage, overtemperature of motor, electronics, or both, overcurrent, locked rotor, and dry run (no-load condition).
- I. Fan Array Controller: The factory mounted and wired single point power panel shall include an external disconnect as well as separate motor overloads and disconnect switches for each motor internal to the controller cabinet. The panel shall be UL or ETL

listed. The panel shall be provided with a BACnet compatible controller capable of monitoring the array's airflow via factory wired fan inlet airflow measuring stations, total static pressure, power consumption, RPM, and individual fan alarm status and specific cause of alarm. Controller shall be configurable for fan speed control. Control panel shall be equipped with relays for locking between other electrically driven components. Control panel shall be pre-wired from internal fan disconnect switches to fan modules.

2.2 SOURCE QUALITY CONTROL

- A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.
- B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210/ASHRAE 51, "Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install fan arrays level and plumb within associated air handling equipment.
- B. Disassemble and reassemble units, as required for moving to the final location, according to manufacturer's written instructions.
 - 1. After field assembly, test and confirm balance and vibration levels. Rebalance as required to meet specified levels.
- C. Lift and support units with manufacturer's designated lifting or supporting points.
- D. Install units with clearances for service and maintenance.
- E. Label fans according to requirements specified in Division 20 Section "Mechanical Identification."

3.2 CONNECTIONS

- A. Ground equipment according to Division 26 Section "Grounding and Bonding."
- B. Connect wiring according to Division 26 Section "Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

- B. Perform the following field tests and inspections and prepare test reports:
 - 1. Verify that shipping, blocking, and bracing are removed.
 - 2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 - 3. Verify that cleaning and adjusting are complete.
 - 4. Adjust damper linkages for proper damper operation.
 - 5. Verify lubrication for bearings and other moving parts.
 - 6. Refer to Division 23 Section "Testing, Adjusting, and Balancing" for testing, adjusting, and balancing procedures.
 - 7. Remove and replace malfunctioning units and retest as specified above.
- C. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain fan arrays. Refer to Division 20 Section "Mechanical General Requirements."

END OF SECTION 233417

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Motors."
 - 3. Division 20 Section "Variable Frequency Controllers."
 - 4. Division 23 Section "Common Work Results for HVAC" for common mechanical drive requirements for fans and air moving equipment.

1.2 PERFORMANCE REQUIREMENTS

- A. Classify according to AMCA 99.

1.3 ACTION SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:
 - 1. Certified fan performance curves with system operating conditions indicated.
 - 2. Certified fan sound-power ratings.

3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
4. Material thickness.
5. Dampers, including housings, linkages, and operators.
6. Roof curbs.
7. Fan speed controllers.

1.4 INFORMATIONAL SUBMITTALS

- A. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 1. Wiring Diagrams: Power, signal, and control wiring.
 2. Design Calculations: Calculate requirements for selecting vibration isolators and for designing vibration isolation bases.
 3. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.
- B. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 1. Roof framing and support members relative to duct penetrations.
 2. Ceiling suspension assembly members.
 3. Size and location of initial access modules for acoustical tile.
 4. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

1.5 CLOSEOUT SUBMITTALS

- A. Field quality-control test reports.
- B. Operation and Maintenance Data: For power ventilators to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.
- B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.
- C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.
- D. UL Standard: Power ventilators shall comply with UL 705.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver fans as factory-assembled units, to the extent allowable by shipping limitations, with protective crating and covering.
- B. Disassemble and reassemble units, as required for moving to final location, according to manufacturer's written instructions.
- C. Lift and support units with manufacturer's designated lifting or supporting points.

1.8 COORDINATION

- A. Coordinate size and location of structural-steel support members.
- B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- C. Coordinate delivery and placement of roof curbs, and equipment supports. Installation of roof curbs, equipment supports, and roof penetrations is specified in Division 07 Section "Roof Accessories."

1.9 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

PART 2 - PRODUCTS

2.1 IN-LINE CENTRIFUGAL FANS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Acme Engineering & Manufacturing.
 - 2. Aerovent.
 - 3. Greenheck Fan Corporation; SQ/BSQ Series.
 - 4. Loren Cook Company.
 - 5. Moffitt Corporation.
 - 6. PennBarry.
 - 7. Soler & Palau.
- B. Description: In-line, direct centrifugal fans consisting of housing, wheel, outlet guide vanes, fan shaft, bearings, motor and disconnect switch, drive assembly, mounting brackets, and accessories.
- C. Casing: Rectangular or cylindrical, flanged.
- D. Throat and Mounting Assembly: One-piece spun aluminum or continuously welded assembly.
 - 1. Stiffeners: Continuously welded.
 - 2. Bolts, nuts, rivets, and washers: Cadmium plated.

3. Nuts: Self-locking type, vibration proof.
- E. Direct-Driven Units: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing; with wheel, inlet cone, and motor on swing-out service door.
- F. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.
- G. Fan Wheels: Aluminum, backward curved airfoil blades welded to aluminum hub.
- H. Accessories:
- I. Capacities and Characteristics: Refer to schedule(s) on Drawings.
- J. Vibration Isolators: Refer to Division 20 Section "Mechanical Vibration Controls."

2.2 CENTRIFUGAL ROOF VENTILATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Acme Engineering & Manufacturing; Acme Fan Group; Models PRN and PV.
 2. Twin City Fan Company.
 3. Greenheck Fan Corporation; Models G and GB.
 4. Loren Cook Company; Models ACED and ACES.
 5. Moffitt Corporation.
 6. PennBarry; Domex.
 7. Soler & Palau.
- B. Description: Direct- or belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.
- C. Housing: Removable, spun-aluminum, dome top and outlet baffle; square, one-piece, aluminum base with venturi inlet cone.
- D. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.
 1. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
 2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
 3. Sheaves: Cast-iron, adjustable-pitch motor sheave.
 4. Fan and motor isolated from exhaust airstream.
 5. Refer to Division 23 Section "Common Work Results for HVAC" for additional requirements.
- E. Accessories:
 1. Variable Frequency Controller: Refer to Division 20 Section "Variable Frequency Controllers."
 2. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
 3. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.

4. Motorized Dampers: Parallel-blade dampers mounted in curb base with electric actuator; wired to close when fan stops.
- F. Provide prefabricated roof curbs for each fan.
- G. Capacities and Characteristics: Refer to schedule(s) on Drawings.

2.3 ROOF CURBS AND ACCESSORIES

- A. Construction: Galvanized steel; mitered and welded corners; 1-1/2-inch- thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch chemically treated wood nailer. Size as required to suit roof opening and fan base.
 1. Manufacturers: Roof curbs shall be provided by the fan manufacturer, or one of the following:
 - a. Creative Metals.
 - b. The Pate Company.
 - c. Roof Products & Systems.
 - d. Thybar Corporation.
 - e. Any of the approved roof mounted exhaust fan manufacturers.
 2. Configuration: Self-flashing without a cant strip, with mounting flange, and suitable for flat roofs with tapered insulation.
 3. Height: Curb shall extend a minimum 18 inches above top surface of roof insulation.
 4. Metal Liner: Galvanized steel.
- B. Construction: Galvanized steel; mitered and welded corners; 1-1/2-inch- thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch chemically treated wood nailer. Size as required to suit roof opening and fan base.
 1. Manufacturers: Roof curbs shall be provided by the fan manufacturer, or one of the following:
 - a. Creative Metals.
 - b. The Pate Company.
 - c. Roof Products & Systems.
 - d. Thybar Corporation.
 - e. Any of the approved roof mounted exhaust fan manufacturers.
 2. Configuration: Built-in raised cant with step dimension matching insulation thickness, with mounting flange, and suitable for sloped roofs with uniform insulation thickness.
 3. Height: Curb shall extend a minimum 18 inches above top surface of roof insulation.
 4. Pitch Mounting: Manufacture curb for roof slope, top of curb shall be level.
 5. Metal Liner: Galvanized steel.

2.4 MOTORS

- A. Comply with requirements in Division 20 Section "Motors."

2.5 SOURCE QUALITY CONTROL

- A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.
- B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install power ventilators level and plumb.
- B. Secure roof-mounting fans to roof curbs with cadmium-plated hardware. Refer to Division 07 Section "Roof Accessories" for installation of roof curbs.
- C. Support suspended units from structure using threaded steel rods and spring hangers having a static deflection of 1 inch. Vibration-control devices are specified in Division 20 Section "Mechanical Vibration Controls."
- D. Install units with clearances for service and maintenance.
- E. Label units according to requirements specified in Division 20 Section "Mechanical Identification."

3.2 CONNECTIONS

- A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Duct Accessories."
- B. Install ducts adjacent to power ventilators to allow service and maintenance.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding."
- D. Connect wiring according to Division 26 Section "Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Verify that shipping, blocking, and bracing are removed.
 - 2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 - 3. Verify that cleaning and adjusting are complete.

4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
 5. Adjust belt tension.
 6. Adjust damper linkages for proper damper operation.
 7. Verify lubrication for bearings and other moving parts.
 8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
 9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
 10. Shut unit down and reconnect automatic temperature-control operators.
 11. Remove and replace malfunctioning units and retest as specified above.
- B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Adjust belt tension.
- C. Refer to Division 23 Section "Testing, Adjusting, and Balancing" for testing, adjusting, and balancing procedures.
- D. Replace fan and motor sheaves as required to achieve design airflow.
- E. Lubricate bearings.

END OF SECTION 233423

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 23 Section "Metal Ducts."
 - 3. Division 23 Section "Temperature Controls."

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated, include rated capacities, furnished specialties, sound-power ratings, and accessories.
 - 1. Liners and adhesives.
 - 2. Sealants and gaskets.

1.3 INFORMATIONAL SUBMITTALS

- A. Shop Drawings: Detail equipment assemblies and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Include a schedule showing unique model designation, room location, model number, size, and accessories furnished.
 - 2. Wiring Diagrams: Power, signal, and control wiring.