



Woodland Cove Phase 1 3102 Cranberry Highway Wareham, MA 02532

Prepared for:

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1264 Main Street
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100% Construction Documents
September 22, 2020
Revised February 16, 2021

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- 2.02 SUBSURFACE ASSESSMENT SUMMARY DATED 11/17/2017 PREPARED BY: GREEN ENVIRONMENTAL**
- 2.03 LIMITED HAZARDOUS MATERIALS SURVEY - MOTEL BUILDING 3102-3104 CRANBERRY HIGHWAY, WAREHAM MA. NOVEMBER 2020, GREEN ENVIRONMENTAL**
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Briggs Engineering & Testing
A DIVISION OF PK ASSOCIATES, INC.

Dakota Partners
c/o Mr. Mark Pilotte
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November 27, 2020
Briggs Project No. 31444

**RE: Geotechnical Investigation Report
Proposed Residential Complex
at 3102 Cranberry Highway, Wareham, MA**

Briggs Engineering & Testing, A Division of PK Associates (Briggs) has completed our investigation of the subsurface conditions at the above referenced location and completed this Geotechnical Report. These services were accomplished in accordance with your authorization of Proposal No. MA. 02.1837.0 dated October 4, 2020. Site investigations were accomplished under the direction of Bart D. Bauer, Massachusetts Registered Professional Engineer (P.E.). This report was prepared under the direction of the above P.E and cosigned and stamped by that P.E.

1.0 Project Location and Description

The site is located in the east edge of Wareham about 0.6 mile south of Route 25, about 0.5 mile west of Buttermilk Bay and 0.3 miles northeast of Broad Cove. Onset Bay is located about 1.2 miles southwest of the site, and is just beyond Broad Cove. The site located on the north side of Cranberry Highway and Red Brook Road.

The site is wooded property with a clearing in the southeast part of the site and an existing motel in the southwest corner of the site. The tree line separating the wooded areas from the generally treeless southeast part of the site is shown on the attached Figure 1. The front of the project site wraps around a property containing an existing dwelling and three out-buildings. Several apparent dumped piles of soil exist along the tree line and extending about 10 to 40 feet into the wooded area to the northwest.

The proposed construction will be four residential buildings plus a Community Building. These buildings are labeled A, B, E and F on the attached Figure 1. All buildings will be slab on grade construction. The residential buildings are 3 or 4 stories high. The proposed Community Building will be one story high. Proposed design bearing is 2000 PSF

Three of the residential buildings are located along the west and north ends of the site and the fourth is located in the northeast part of the site. A U-shaped access road with parking on both sides extends around the outside edge of the site. The interior and southeast parts of the site are open grassy areas with walkways. Refer to the attached Figure 1 for site layout.

Proposed slab grades for the buildings are as follows:

<u>Building</u>	<u>Slab Elev. (ft)</u>
A	76.5
B	75.4
E	70.0
F	76.4
Community Ctr.	78.0

Several utilities including electric, natural gas, telephone, sewage disposal, storm drains and water are located around the site. Dig Safe utility clearance was accomplished by the Drilling Contractor prior to commencing investigations by test borings. No subsurface utilities were located inside the project site except along the frontage extending about 20 feet onto the site.

2.0 Subsurface Explorations

The subsurface conditions at the Site were explored under the supervision of the undersigned Briggs' Geotechnical Dept. Manager. The explorations consisted of advancing fourteen (14) test borings at or near the proposed building areas as shown on attached Figure 1.

The borings were advanced on November 3 through 6, 2020 by Sage Environmental of Pawtucket, RI. All borings were drilled using a geo-probe, track-mounted drill rig with split spoon samples collected every five feet as indicated on the test boring logs. Soils between sample depths were drilled using solid casing and extracted by drill and wash techniques. Borings were accomplished via ASTM D1586, "Penetration Test and Split Barrel Sampling of Soils". Standard Penetration Tests (SPT) as noted on the attached test boring logs.

2.1 Test Borings

Test boring depths (in feet) below ground surface (BGS) at each boring is tabulated as follows:

<u>Boring</u>	<u>Boring Depth BGS</u>
B-1	62 ft
B-2	32 ft
B-3	27 ft
B-4	27 ft
B-5	27 ft
B-6	57 ft

<u>Boring</u>	<u>Boring Depth BGS</u>
B-7	27 ft
B-8	27 ft
B-9	27 ft
B-10	22 ft
B-11	57 ft
B-12	27 ft
B-13	27 ft
B-14	27 ft

Soil samples for all explorations were field classified by David Geisser, Geotechnical Dept. Manager, on a full-time basis using the Bermister Soil Classification System. Soil descriptions by Briggs are presented in the attached test boring logs and discussed below. Strata change depths are noted in the test boring logs.

3.0 Subsurface Conditions

Soils stratigraphy consists of topsoil and subsoil in places over sands, silty sands and gravely silty sands to bottom of test borings at 22 to 62 feet BGS. These soils are discussed below:

Topsoil – silty sands with little to some (20 to 35%) non-plastic fines (silt) and trace (less than 10%) organic content was found at ground surface in all borings except B-7. The topsoil extends to 0.7 to 1.5 feet BGS. The topsoil is generally dark brown and loose with N-Values¹ of 1 to 5 when combined with the underlying subsoil layer sampling interval.

Subsoil – silty sands with little to some (20 to 35%) silt was found at ground surface in all borings except B-10. The subsoil strata extends to 1.5 to 3 feet BGS. The subsoil is generally orange brown and loose with N-Values of 1 to 5 when combined with the underlying subsoil layer sampling interval.

Undisturbed Sands – Sands with trace or no gravel and trace silt were encountered immediately below the topsoil and subsoil in all borings except B-4, B-5 and B-9. The sandy stratum extends to depths of 15 feet or deeper. These sandy deposits are generally light brown, stratified in places and loose to medium dense with SPT N-Values ranging from 4 to 29, generally increasing with depth.

Silty Sands – Undisturbed silty sands were found directly under topsoil and subsoil in B-4, B-5 and B-9 and in other borings below the sand stratum. Silty sands were absent from B-7, B-12, B-13 and B-14. The silty sands at these locations extend to about 8 to 27 feet BGS and from 45 to 57 feet a B-6 and at 50 feet in B-11. The silty sands have little silt and trace or no gravel and are generally light brown to light grey brown and loose to medium dense with an N-Value of 6 to 21 except a B-6 and B-11 with N-Values at 22 to 47 below 45 feet depth and is medium dense to dense.

¹ SPT N-Value is the number of blows for a 140 lb. hammer falling freely through 30 inches, required to advance the standard split spoon sampler the last 12 inches of an 18 inch sampling interval.

Gravelly Silty Sands – Undisturbed gravelly silty sands were found interbedded with the sands and silty sands below the topsoil and subsoil layers.

The gravelly silty sands have little to some gravel and little silt and are generally light brown to light grey brown and medium dense to dense with a N-Values of 12 to 45 except a B-6 and B-11 with N-Values at 22 to 47 below 45 feet depth and is medium dense to dense.

Refusal – No refusals were encountered within depths drilled to maximum 62 feet BGS.

3.1 Groundwater

Upon completion of each test boring and at later times up to 1.5 days later, a tape measure with hollow “plunker” device was lowered into the bore-hole to measure water depths. All borings were advanced via drive and washed casing methods starting at 15 feet introducing water to about 5 feet BGS for samples collected at 15 feet and deeper. Soil samples were moist to dry above 15 feet. Soil samples collected below 20 feet were wet. Drilling casing was removed in all borings upon completion and water was measured at the following depths:

<u>Boring</u>	<u>Water Depth</u>
B-1	21.4
B-2	19.0
B-3	19.6
B-4	21.3
B-5	21.4
B-6	29
B-7	26.8
B-8, B-10	NE
B-9	23.8
B-11	19.2
B-12	18.5
B-13	19
B-14	18.5

Based on our observations and measurements, Briggs estimates groundwater depths at about 18 to 29 feet BGS with deeper groundwater at higher elevations across the front of the site and shallower groundwater to the rear of site. Apparent groundwater flow gradient is toward the rear (north) toward Sand Pond, located northwest of the project site, generally following surface topography.

Groundwater levels may be affected by local anomalous conditions such as underground utilities or confining silty or clayey soils as well as seasonal factors and thus may not represent the level to be encountered in the future. Generally, groundwater levels are highest in the spring and lowest in the late fall. The borings were completed in early November when groundwater levels are typically deeper to moderate.

4.0 FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

4.1 Foundation Design

We recommend that the proposed buildings be supported on continuous wall and spread footings bearing on the proof rolled undisturbed inorganic granular soils (sands, silty sands and gravelly silty sands) with a minimum 12-inch thick layer of compacted Structural Fill or Crushed Stone over the granular subgrade.

Site re-grading and compaction will be required to provide gentler slopes from the south and southeast parts of the site to lower grades to the northwest. Footing excavations must extend through these fills to undisturbed granular subgrade.

Soils at proposed footing grades and deeper have N-Values generally in the range of 6 to 12 blows per foot within the upper 15 feet and generally increasing N-Values below 15 feet depth.

Footings resting on proof rolled sandy subgrade with a 12 inch thick cushion of Structural Fill will have the following allowable bearing pressures in pounds per square foot (psf) based on footing width and depth below slab grade:

<u>Footing Width</u>	<u>Footing Burial Depth</u>	<u>Allowable Bearing</u>
2 feet	4 feet	3600 psf
3 feet	4 feet	3900 psf
4 feet	4 feet	4200 psf

Interior isolated column footings are typically at about 2 feet depth below top of slab and will have the following allowable bearing pressures.

<u>Footing Width</u>	<u>Footing Burial Depth</u>	<u>Allowable Bearing</u>
3 feet	2 feet	2400 psf
4 feet	2 feet	2700 psf
5 feet	2 feet	3000 psf
6 feet	2 feet	3300 psf

Increasing footing widths (interior and exterior) to greater than the above-tabulated widths will increase allowable bearing capacity. Briggs can calculate these capacity values if warranted.

The above allowable capacities include a safety factor of 3.0, therefore ultimate capacities are triple the allowable capacities presented in this report. Footing design should be based on allowable capacity to include the safety factor.

Total settlement due to the compression of the bearing soils should be less than 1 inch and the total differential settlement should be less than 1/2 inch and should pose no significant structural problems.

Exterior footings should be a minimum of 4.0 feet below finished grade to provide adequate protection against frost heave action. The 4-foot frost depth would also apply to foundations in un-heated interior areas, if any. All footings should be installed at relatively consistent depths. Footings should not extend deeper than a line drawn from adjacent footings at a 2H:1V slope extending down from the higher footings.

Stepped Footings

Wall footings may step up moving northward as site grades drop to the north-northwest across the site. Footing steps should be no steeper than a 1 vertical to 2 horizontal (1V:2H) series of steps or flatter to transition from lower footing to higher footing elevations.

Any utility pipes extending into buildings should pass through the foundation wall rather than passing through or under footings. Wall and interior footings should be lowered to accommodate any such utilities and wall footings must be stepped at 1V:2H on either side of pipe to rise up from footing(s) that are dropped lower to accommodate pipe(s).

Other Geotechnical Design Parameters – Retaining Walls

Site grades slope down moderately in many areas. Briggs expects that site retaining walls will not be required for this project. Should any retaining walls become required, Briggs can provide soil parameters including unit weight, friction angle and earth pressure coefficients based on location of walls and test borings near these walls.

Site retaining walls (if any) must be designed to support retained fills, vertical loads of structures, sloped backfill on retained soil sides (if any) and any other surcharge loads on retained soil sides of walls. All retaining walls should be designed with drains on retained soil side of walls. Refer to Section 4.4 for details regarding recommended drain installation. Also, backfill and compaction against the backfilled side of retaining walls must be accomplished using lighter vibratory compactors and thinner fill lifts. Briggs can also provide additional recommendations for compaction based on wall height and wall design.

4.2 Seismic Design

The undisturbed granular subgrade, compacted Structural and Granular Fills and Crushed Stone are not susceptible to liquefaction during the postulated seismic event given their gradation, depth to groundwater and relative densities within the depths explored. Soil relative density is generally increasing with depth to the maximum depth of 62 feet. Also, some of the explored soils are sands containing varying gravel and silt with gradation not susceptible to liquefaction during postulated seismic event. This evaluation is in accordance with the International Building Code, 9th Edition with Massachusetts State Amendments.

The explored soils for the proposed buildings are Seismic Site Classification D in accordance with Table 20.3-1 of ASCE 7-10 as the average N-Value for deep borings B-1, B-6 and B-11 is extrapolated at 20 to 25 blows in the upper 100 feet of soil depth.

Seismic parameters for Wareham as found in Table 1604.11 of the 9th editions of the Massachusetts Building Code are $S_s = 0.173$ and $S_1 = 0.059$.

4.3 Excavation and Subgrade Protection

Topsoil, subsoil and existing fills must be excavated from all proposed structural areas including building areas, pavements, walkways and exterior slabs to the surface of the undisturbed sands, silty sands and gravelly sands.

Organic soils (topsoil and subsoil) should be piled separately for reuse in proposed landscape areas or disposed offsite. Fill soils and fill piles appear to exist along the transition from the open southeast part of the site to lower grades to the northwest. These piles are near the tree-line shown on Figure 1. The topsoil, subsoil and fill materials must be excavated from the entire building areas plus foundation stress zones. The stress zone is the volume of soil under footing plus wedges of soil extending down and out from all edges of footing at a 45-degree angle or as indicated in IBC, 9th Edition, whichever is greater lateral excavation.

Refuse and cut pieces of trees and limbs are located on the northwest and north portions of the open area in the middle of the site. These materials must be removed from the site.

Footing area excavations must extend to the surface of the sands and silty sands bearing strata and to a minimum depth of one foot below Boom Of Footing (BOF) grades. Therefore most excavations will extend about 3 to 6 feet below current grades.

Dewatering will not likely be necessary for any of the excavations except possibly after heavy rainstorms.

Excavated sands, gravelly silty sands and silty sands can be combined and blended to create a sandy blend that is likely suitable as Granular Fill provided the material meets gradation recommendations presented in Section 4.6 of this report.

Proof Rolling - Resulting sandy subgrades at 1 foot or deeper below BOF grades must be proof rolled by making at least 10 passes using a vibratory roller weighing at least 5 tons, static weight. This will typically require widening the footing trenches to about 7 feet width. The proof rolling will compact loose zones in the upper portion of the undisturbed sandy bearing stratum. Dry sand subgrades must be moistened prior to compacting or proof rolling and must be maintained in a moist compact condition until footings or subsequent lifts of fill are placed and compacted.

Backfill over exposed wet subgrades should be covered with an initial 12-inch thick layer of $\frac{3}{4}$ inch minus crushed stone. The initial layer of crushed stone should be proof rolled using a 1-ton vibratory roller making 10 passes. Excavation, backfilling and proof rolling should be witnessed by a Geotechnical Engineer or designated representative. The Geotechnical Engineer would also determine if the bearing subgrade relative density is consistent with the test boring data and has been properly proof rolled. The

Engineer would also determine if the subgrade has become disturbed by excavation, drying out or water movement. Any weak, soft, spongy or unstable zones should be excavated and replaced with compacted Structural Fill or Crushed Stone as discussed in Section 4.6 of this report.

The undisturbed sandy subgrade will be easily disturbed if dry and walked upon or driven over by typical construction traffic. If the subgrade becomes wet, it should be allowed to dry or be excavated to moist or dry subgrade prior to placing footings or fills. Backfills above observed groundwater should be Structural Fill and/or Granular Fill as discussed in Section 4.6. Structural fill should be placed over moist to dry silty sands subgrades as soon as possible to protect these areas from softening water.

Unsupported excavations should slope up from the bottom of excavation in compliance with OSHA guidelines/standards. If excavation to proposed foundation grades extend deeper than 4 feet below footing grade, then these excavations should slope away from the excavation areas. If the Contractor chooses to use trench boxes or other lateral earth support measures, the lateral support systems must be designed by the Contractors' Engineer.

Excavation effort should be easy to moderate to reach the undisturbed, inorganic granular subgrade. Bedrock removal is not anticipated as refusals were not encountered in any of the test borings to 62 feet BGS. However, if bedrock extends above footings, slabs or proposed utility elevations, then removal can be accomplished by blasting, hoe ramming or hydraulic wedge and splitting methods depending on local, state and federal regulations.

Boulders and cobbles may be encountered in soils within the proposed excavation zone. An excavator would typically be used to remove soils, cobbles and boulders in proposed foundation areas.

4.4 Water Control

Groundwater was not found within the anticipated excavation depths of about 6 feet BGS. The shallowest groundwater was found at 18.5 feet BGS. Water seepage could occur at shallower depths due to rainfall as perched water seeps through the ground and enters excavation areas during and after rainy weather.

Subgrades that become wet by rain should not be traveled on or they may become disturbed. Disturbed soils should be excavated and be replaced by compacted lifts of crushed stone wrapped by filter fabric in proposed structural areas. These conditions might occur as silty sands were found below the fill and undisturbed sandy layers and could exist at other locations immediately below the fill and organic layers.

Water infiltration into excavations should be monitored during the construction phase. Additional dewatering recommendations should be made if water seepage is observed within the depths of proposed excavations.

All backfilling must be placed “in the dry” after water is pumped to at least 6 inches below the base of excavations. Sumps and pumps must be installed to pump water from excavations to allow backfilling and compaction in building and pavement areas.

Surface drainage should be directed away from excavations during construction so that the bearing surfaces do not become softened by water flow or puddling. Rapid water movement can also scour soils and undermine foundations, therefore surface water protection such as earth berms should be constructed around perimeter of excavations. This can be accomplished with proper grading or construction of small dikes at the top of slope of the excavations.

Damp-proofing of all foundations is recommended. The damp-proofing should reduce but not eliminate moisture infiltration through foundation walls. Vapor barrier or retarder should be installed under all slab areas if specified by the Architect. Briggs does not provide any warrantee against moisture infiltration or mildew or bacterial growth in the below grade space.

4.5 Proposed Slabs

A minimum 6-inch thick layer of Structural Fill is recommended immediately beneath all proposed slabs after removal of fill and organic soils down to the undisturbed inorganic granular subgrade. The organic soils and existing fills must also be removed from proposed pavement and other structural areas such as transformer pads, etc.

Backfill above footing grade to within 6 inches of underside of interior slabs or within 12 inches below bottom of exterior slabs, pavements or concrete walkways can be Granular Fill as referenced in Section 4.6. However, Granular Fill must not be used in foundation stress zones.

A modulus of vertical subgrade reaction of 100 pound per cubic inch (pci) would apply to slabs resting on compacted Structural Fill over the undisturbed, inorganic granular subgrade or compacted Granular Fill.

Hydrostatic uplift design will not be necessary for proposed slabs at depths of proposed slab on grade. Additional investigations may be necessary to evaluate need for uplift design if any slabs are to be constructed lower than 10 feet BGS.

4.6 Backfill and Compaction

Silty sands, gravelly silty sands and sands excavated in proposed building and pavement and slab areas can likely be reused as Granular Fill to depths previously noted below base of slabs and pavements provided these inorganic soils can be compacted to 95% of their maximum dry unit weight and gradation meets the recommendations listed below in Section 4.6. All footing stress zones must be filled with Structural Fill, not Granular Fill. Some of this material may be moisture sensitive if silty sands with more than 15% silt are encountered. Silty sands may be very difficult or impossible to adequately compact if they becomes wet by rain or is excavated below the water table. These materials can be blended with less silty soils to provide a more

compactible fill. Wet silty sands should be segregated from dry silty sands so that the dry materials might be re-useable as compacted Granular Fill provided they meet the Granular Fill gradation recommendations presented later in this section.

Deep fill areas in the proposed building area can be bulk filled with crushed stone to surface of observed groundwater then by compacted lifts of Granular Fill to slab base-course grades. The stone would be placed in one-foot lifts with each lift being compacted by three passes. Excavation below groundwater is not expected for this project, therefore these recommendations will not likely be applicable.

Structural Fill should be placed on the subgrade soils within the stress zones of all footings. Gradation for Structural Fill is listed later in this section. The foundation stress zone is the volume of soil extending down and out from all sides of the footing at a 45-degree angle.

Within the areas excavated for footings, walls, and other limited areas where large compaction equipment cannot work, we recommend that the fill be placed in loose lifts no more than six inches in thickness and be compacted with small hand manipulated machines such as pneumatic compactors, vibratory compactors, etc. In areas where large vibratory compactors such as a Raygo 400A or equivalent can be used, we recommend that the loose lift thickness not exceed 12 inches.

All backfill placed in load bearing areas including under slabs and under footings should be compacted to a minimum of 95% of the maximum dry density as determined by the test designated modified ASTM D1557.

Crushed stone layers requires compaction by making at least three passes by a vibratory plate compactor or vibratory roller with minimum static weight of 400 pounds per 12 inch maximum lift thickness. No compaction testing will be necessary for the crushed stone fills. Crushed stone fills thicker than 12 inches should be placed in one-foot lifts and be monitored by a Technician or Geotechnical Engineer.

Backfill Materials Gradation Recommendations:

Crushed stone should have the following gradation:

CRUSHED STONE

U.S. Sieve Size & Number	Percent Passing	
	Maximum	Minimum
1 inch	---	100
3/4 inch	100	90
1/2 inch	50	10
3/8 inch	20	0
No. 4	5	0

Structural Fill should consist of well-graded natural sands and gravel or crushed concrete. Structural Fill should be free from excessive plastic fines, organic matter and deleterious material including asphalt, and should have the following gradation:

RECOMMENDED STRUCTURAL FILL GRADATION

U.S. Sieve Size & Number	Percent Passing	
	Maximum	Minimum
2/3 lift thickness	100	100
1 inch	100	60
No. 4	85	25
No. 20	60	10
No. 50	35	4
No. 200	8*	0

* Backfill within three (3) feet laterally of earth retaining walls or basement walls shall have 5% or less material passing the #200 sieve.

Granular Fill under proposed building space should be free of appreciable asphalt content as this can off-gas into occupied space causing possible health concerns. Granular Fill should consist of well graded natural sands and gravel free from excessive plastic fines, organic matter and deleterious material, and should have the following gradation:

RECOMMENDED GRANULAR FILL GRADATION

U.S. Sieve Size & Number	Percent Passing	
	Maximum	Minimum
2/3 lift thickness	100	100
1 inch	100	60
No. 4	90	25
No. 200	25	0

5.0 Limitations and Exclusions

All the professional opinions presented in this report are based solely on the scope of work conducted and sources referred to in our report. The data presented by Briggs in this report were collected and analyzed using generally accepted industry methods and practices at the time the report was generated. This report represents the conditions, locations, and materials that were observed at the time the field-work was conducted. No inferences regarding other conditions, locations, or materials, at a later or earlier time may be made based on the contents of the report. No other warranty, express or implied is made.

This report was prepared for the sole use of our client. The use of this report by anyone other than our client or Briggs is strictly prohibited without the express prior written

consent of Briggs. Portions of the report may not be used independently of the entire report.

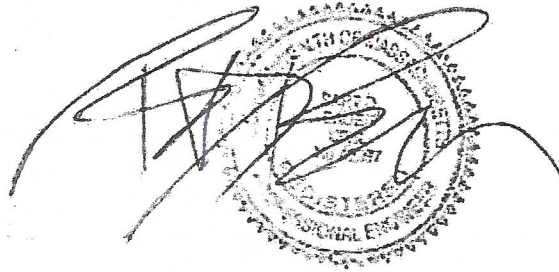
The above recommendations and conclusions are based on our evaluation of the obtained data presented in the text. We would welcome the opportunity to monitor the pertinent phases of the foundation construction; thus, if differences are found between the field conditions described herein and those encountered during construction, we can modify our recommendations in a timely and professional manner.

Thank you for engaging our services to undertake this project. If you have any questions, please do not hesitate to contact us at your convenience.

Very truly yours,
Briggs Engineering & Testing



David W. Geisser
Geotechnical Dept. Manager



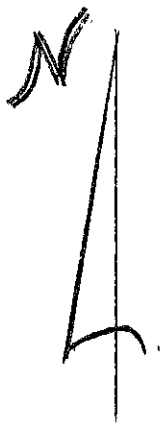
Bart D. Bauer, PE
Professional Engineer

DWG:BDB:dg

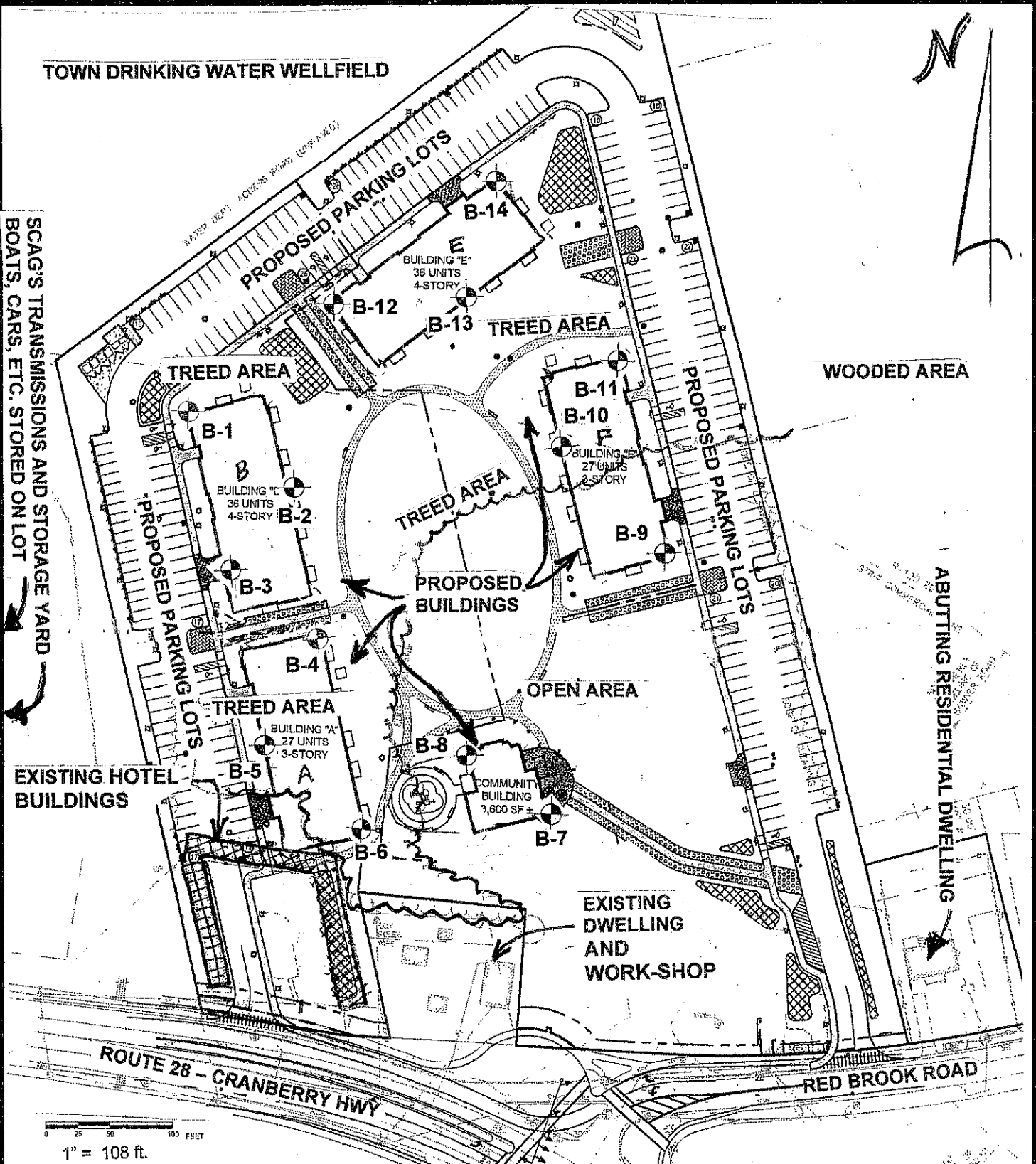
Enclosures:

Figure 1 – Location Plan
Test Boring Logs

TOWN DRINKING WATER WELLFIELD



SCAG'S TRANSMISSIONS AND STORAGE YARD -
BOATS, CARS, ETC. STORED ON LOT



EXISTING HOTEL BUILDINGS

EXISTING DWELLING AND WORK-SHOP

ABUTTING RESIDENTIAL DWELLING

ROUTE 28 - CRANBERRY HWY

RED BROOK ROAD

0 25 50 100 FEET
1" = 108 ft.



Briggs Engineering & Testing
A Division of PK Associates, Inc.

LEGEND

- ⊙ Number and approx.
- B-1 Location of test boring.

NOTES:

Plan developed from "Overall Layout and Materials Plan", by BSC Group of Boston, Ma. Rev. 8/10/18

**TEST BORINGS LOCATION PLAN
PROPOSED WOODLAND COVE
3102 CRANBERRY HIGHWAY
WAREHAM, MA**

Scale: N.T.S.	Drawn: DWG	FIG. 1
NOV 5, 2020	Check: DWG	

SAGE Environmental, Inc.

GEOTECH BORING LOG

PROJECT: 3102 Cranberry Hwy
 LOCATION: Wareham MA
 DRILLING CO: Sage
 EQUIPMENT: Geoprobe
 DRILLED BY: S. Perry

BORING NO. B-1
 PAGE 1 OF 1
 DATE STARTED: 11-5-20
 DATE FINISHED: 11-5-20
 SURFACE ELEVATION: _____

GROUNDWATER OBSERVATIONS

NOT ENCOUNTERED:

At 21.4 after 30 hours
 At _____ after _____ hours

WELL CASING _____ WELL SCREEN _____

TYPE: _____ SIZE ID: _____

SAMPLING DEPTH (feet)	SAMPLE TYPE	HAMMER BLOWS ON SAMPLER (inches)				Strata Change (feet)	Sample ID			LITHOLOGY (Description of materials)
		0-6	6-12	12-18	18-24		No.	Pen	Rec	
0-2	SS	1	1	1	2		1	24	20	Surface: Topsoil - f/m Sand, some silt, trace organic black moist Subsoil - f/m Sand, some silt, orange brown
						0.9				
2-4		3	3	6	7	1.7	2	24	18	Sand - f/c trace Gravel trace (H) silt, brown
5-7		8	9	8	11		3	24	16	Sand - f/c, trace (H) silt, light brown
10-12		8	7	8	10		4	24	20	Sand - f/c trace (H) gravel, trace silt,
15-17		6	8	8	8		5	24	14	Unstratified, light brown similar to above
20-22		5	8	9	9		6	24	12	Similar to above
25-27		6	10	10	8		7	24	8	Silty Sand - f/c, trace Gravel, little silt, brown
30-32		5	8	9	9		8	24	10	Similar to above
35-37		6	6	10	10		9	24	8	Silty Sand - similar to above, light brown
40-42		8	7	10	11		10	24	6	Similar to above
45-47		6	10	14	14		11	24	8	Gravelly Silty Sand - f/c little Gravel, little silt
50-52		8	9	14	16		12	24	7	Similar to above, light brown
55-57		9	10	10	14		13	24	8	Similar to above
60-62		10	12	12	16		14	24	7	Similar to above
										Bottom of Boring at 62 ft

GENERAL REMARKS:

NA - Not Analyzed
 ND - Not Detected (sample < 1 ppm)
 BGS - Below Surface Gravel

SAGE Environmental, Inc.

GEOTECH BORING LOG

PROJECT: 3102 Cranberry Hwy
 LOCATION: Warcham MA
 DRILLING CO: Sage
 EQUIPMENT: Geoprobe
 DRILLED BY: S. Perry

BORING NO. B-2
 PAGE 1 OF
 DATE STARTED: 11-4-20
 DATE FINISHED: 11-4-20
 SURFACE ELEVATION:

GROUNDWATER OBSERVATIONS

NOT ENCOUNTERED:
 At 19.0 after 23 hours
 At after hours

WELL CASING WELL SCREEN
 TYPE: _____
 SIZE ID: _____

SAMPLING DEPTH (feet)	SAMPLE TYPE	HAMMER BLOWS ON SAMPLER (inches)				Strata Change (feet)	Sample ID			LITHOLOGY (Description of materials)
		0-6	6-12	12-18	18-24		No.	Pen	Rec	
0-2	SS	1	1	1	1	0.7	1	24	16	Surface: Topsoil - f/c sand, little (+) silt, trace organic dk brown
2-4		4	3	4	4	3	2	24	18	Subsoil - f/m sand, some silt, orange brown
5-7		4	4	5	5		3	24	18	Sand - f/m, trace silt, light brown, dry
10-12		1	1	3	4		4	24	16	Similar to above
15-17		8	13	17	15		5	24	12	Sand - f/c, trace gravel, trace silt, light brown
20-22		6	12	14	13		6	24	12	Similar to above
25-27		8	10	10	12		7	24	10	Sand - Similar to above
30-32		10	11	10	11		8	24	10	Silty sand - f/c, trace gravel, little silt, light grey brown
										Bottom of Boring at 32 ft

GENERAL REMARKS:

NA - Not Analyzed
 ND - Not Detected (sample < 1 ppm)
 BGS - Below Surface Gravel

SAGE Environmental, Inc.

GEOTECH BORING LOG

PROJECT: 3102 Cranberry Hwy
 LOCATION: Wareham MA
 DRILLING CO: Sage
 EQUIPMENT: Geoprobe
 DRILLED BY: S. Perry

BORING NO. B-3
 PAGE 1 OF _____
 DATE STARTED: 11-4-20
 DATE FINISHED: 11-4-20
 SURFACE ELEVATION: _____

GROUNDWATER OBSERVATIONS

NOT ENCOUNTERED:
 At 19.6 after 27 hours
 At _____ after _____ hours

WELL CASING _____ WELL SCREEN _____
 TYPE: _____
 SIZE ID: _____

SAMPLING DEPTH (feet)	SAMPLE TYPE	HAMMER BLOWS ON SAMPLER (inches)				Strata Change (feet)	Sample ID			LITHOLOGY (Description of materials)
		0-6	6-12	12-18	18-24		No.	Pen	Rec	
0-2	SS	1	1	1	1	0.8	1	24	16	Surface: Topsoil - f/c, little silt, trace organic, dk brown Subsoil - fine sand, little (+) silt, orange brown
2-4		3	3	5	5	1.5	2	24	18	Sand - f/c, trace Gravel trace (+) silt, brown
5-7		7	7	8	10		3	24	15	Similar to above
10-12		8	8	6	6		4	24	12	Similar to above
15-17		9	7	8	8		5	24	14	Similar to above
20-22		8	8	9	8		6	24	10	Similar to above
25-27		8	9	10	10		7	24	10	Silty Sand - f/c trace Gravel, little silt, light brown
										Bottom of Boring at 27 ft

GENERAL REMARKS:

NA - Not Analyzed
 ND - Not Detected (sample < 1ppm)
 BSG - Below Surface Grade

SAGE Environmental, Inc.

GEOTECH BORING LOG

PROJECT: 3102 Cranberry Hwy
 LOCATION: Wareham MA
 DRILLING CO: Sage
 EQUIPMENT: Geoprobe
 DRILLED BY: S. Perry

BORING NO. B-4
 PAGE 1 OF _____
 DATE STARTED: 11-4-20
 DATE FINISHED: 11-4-20
 SURFACE ELEVATION: _____

GROUNDWATER OBSERVATIONS

NOT ENCOUNTERED:

At 21.3 after 0.5 hours
 At 24.5 after 20 hours

WELL

WELL

CASING

SCREEN

TYPE: _____

SIZE ID: _____

SAMPLING DEPTH (feet)	SAMPLE TYPE	HAMMER BLOWS ON SAMPLER (Inches)				Strata Change (feet)	Sample ID			LITHOLOGY (Description of materials)
		0-6	6-12	12-18	18-24		No.	Pen	Rec	
0-2	SS	1	1	1	2		1	24	16	Surface: Topsoil - f/m Sand, little (H) silt, trace organic, dk brown.
						0.9				Subsoil - f/m Sand, little silt, orange brown
						1.5				
2-4		2	3	3	3		2	24	16	Silty Sand - f/m, little silt, brown, dry
5-7		3	5	7	7		3	24	14	Similar to 2-2
10-12		5	7	7	7		4	24	14	Sand - f/m, trace (H) silt, light brown
15-17		4	4	5	6		5	24	20	Sand - f/m, trace silt, light brown
20-22		6	6	6	7		6	24	20	Similar to above.
25-27		6	7	7	7		7	24	18	Similar to above
										Bottom of Boring at 27 ft.

GENERAL REMARKS:

NA - Not Analyzed
 ND - Not Detected (sample < 1ppm)
 BGS - Below Surface Grains

SAGE Environmental, Inc.

GEOTECH BORING LOG

PROJECT: 3102 Cranberry Hwy
 LOCATION: Wareham MA
 DRILLING CO: Sage
 EQUIPMENT: Geoprobe
 DRILLED BY: S. Perry

BORING NO. B-5
 PAGE 1 OF 1
 DATE STARTED: 11-4-20
 DATE FINISHED: 11-4-20
 SURFACE ELEVATION: _____

GROUNDWATER OBSERVATIONS

NOT ENCOUNTERED:
 At 21.4 after 3 hours
 At _____ after _____ hours

WELL _____ WELL SCREEN _____
 CASING _____
 TYPE: _____
 SIZE ID: _____

SAMPLING DEPTH (feet)	SAMPLE TYPE	HAMMER BLOWS ON SAMPLER (inches)				Strata Change (feet)	Sample ID			LITHOLOGY (Description of materials)
		0-6	6-12	12-18	18-24		No.	Pen	Rec	
									Surface: <u>Topsoil - f/c Sand</u> <u>some silt, trace organic</u> <u>dk brown</u>	
<u>0-2</u>	<u>SS</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>2</u>	<u>0.8</u>	<u>1</u>	<u>24</u>	<u>16</u>	<u>Subsoil - f/m Sand</u> <u>little (+) silt, orange</u> <u>brown</u>
<u>2-4</u>		<u>2</u>	<u>3</u>	<u>4</u>	<u>4</u>	<u>2.5'</u>	<u>2</u>	<u>24</u>	<u>20</u>	<u>Silty Sand - f/c, trace</u> <u>gravel, little silt,</u> <u>light brown</u>
<u>5-7</u>		<u>4</u>	<u>6</u>	<u>6</u>	<u>8</u>		<u>3</u>	<u>24</u>	<u>18</u>	<u>Sand - f/m, trace (+)</u> <u>silt, stratified,</u> <u>light brown</u>
<u>10-12</u>		<u>8</u>	<u>9</u>	<u>11</u>	<u>11</u>		<u>4</u>	<u>24</u>	<u>10</u>	<u>Similar to S-3</u>
<u>15-17</u>		<u>6</u>	<u>8</u>	<u>10</u>	<u>10</u>					<u>Similar to above</u>
<u>20-22</u>		<u>7</u>	<u>7</u>	<u>10</u>	<u>10</u>					<u>Similar to above</u>
<u>25-27</u>		<u>6</u>	<u>12</u>	<u>14</u>	<u>13</u>					<u>Gravelly Silty Sand -</u> <u>f/c, little gravel, little</u> <u>silt, grey</u>
										<u>Bottom of Boring</u> <u>at 27 ft</u>

GENERAL REMARKS:

NA - Not Analyzed
 ND - Not Detected (sample < 1ppm)
 BGS - Below Surface Ground

SAGE Environmental, Inc.	GEOTECH BORING LOG
PROJECT: <u>3102 Cranberry Hwy</u>	BORING NO. <u>B-6</u>
LOCATION: <u>Wareham, MA</u>	PAGE 1 OF _____
DRILLING CO: <u>Sage</u>	DATE STARTED: <u>11-3-20</u>
EQUIPMENT: <u>Geoprobe</u>	DATE FINISHED: <u>11-3-20</u>
DRILLED BY: <u>S. Perry</u>	SURFACE ELEVATION: _____
GROUNDWATER OBSERVATIONS	WELL CASING _____ WELL SCREEN _____
NOT ENCOUNTERED:	TYPE: _____
At <u>29</u> after <u>0.1</u> hours	SIZE ID: _____
At <u>29.3</u> after <u>36</u> hours	

SAMPLING DEPTH (feet)	SAMPLE TYPE	HAMMER BLOWS ON SAMPLER (inches)				Strata Change (feet)	Sample ID			LITHOLOGY (Description of materials)
		0-6	6-12	12-18	18-24		No.	Pen	Rec	
0-2	SS	1	1	1	2		1	24	20	Surface: Topsoil - f/m Sand, some silt, trace organic, dk brown
2-4		3	3	4	4	0.8	2	24	14	Subsoil - f/m Sand, some silt, orange brown
						2.5'				
5-7		5	7	6	6		3	24	8	Sand - f/m, trace silt, light brown
10-12		3	3	3	3		4	24	16	Similar to above
15-17		3	4	3	4		5	24	20	Similar to above, faint horizontal stratification.
20-22		4	4	5	7		6	24	18	Similar to S-5
25-27		9	7	7	8		7	24	20	Similar to S-5
30-32		4	5	5	7		8	24	16	Similar to S-5, wet
35-37		5	6	8	8		9	24	14	Similar to S-8
40-42		6	6	8	13		10	24	16	Sand - f/c, trace Gravel, trace silt, brown
45-47		8	13	19	23		11	24	18	Silty Sand - f/m, little silt, stratified, light brown, wet
50-52		11	18	26	21		12	24	16	Similar to S-11
55-57		10	19	28	28		13	24	15	Similar to S-11
										BOTTOM OF BORING AT 57FT

GENERAL REMARKS:

NA - Not Analyzed
 ND - Not Detected (sample < 1ppm)
 BSG - Below Surface Grade

PROJECT: 302 Cranberry Hwy
 LOCATION: Wareham, MA.
 DRILLING CO: Sage
 EQUIPMENT: Geoprobe
 DRILLED BY: S. Perry

BORING NO. B-7
 PAGE 1 OF _____
 DATE STARTED: 11-3-20
 DATE FINISHED: 11-3-20
 SURFACE ELEVATION: _____

GROUNDWATER OBSERVATIONS

NOT ENCOUNTERED:

At 26.8 after 2 hours
 At 26.9 after 28 hours

WELL

WELL

CASING

SCREEN

TYPE: _____

SIZE ID: _____

SAMPLING DEPTH (feet)	SAMPLE TYPE	HAMMER BLOWS ON SAMPLER (inches)				Strata Change (feet)	Sample ID			LITHOLOGY (Description of materials)
		0-6	6-12	12-18	18-24		No.	Pen	Rec	
<u>0-2</u>	<u>GS</u>	<u>5</u>	<u>5</u>	<u>4</u>	<u>4</u>		<u>1</u>	<u>24</u>	<u>22</u>	Surface: Subsoil - f/m, some silt, orange brown
<u>2-4</u>		<u>4</u>	<u>4</u>	<u>5</u>	<u>5</u>	<u>1.5</u>	<u>2</u>	<u>24</u>	<u>20</u>	Sand - f/m, trace (+) gravel, trace silt, light brown, dry
<u>5-7</u>		<u>5</u>	<u>4</u>	<u>4</u>	<u>4</u>		<u>3</u>	<u>24</u>	<u>18</u>	Sand - f/m, trace (+) silt, light brown
<u>10-12</u>		<u>3</u>	<u>3</u>	<u>3</u>	<u>4</u>		<u>4</u>	<u>24</u>	<u>16</u>	Similar to above
<u>15-17</u>		<u>4</u>	<u>4</u>	<u>5</u>	<u>5</u>		<u>5</u>	<u>24</u>	<u>18</u>	Similar to above
<u>20-22</u>		<u>5</u>	<u>5</u>	<u>5</u>	<u>6</u>		<u>6</u>	<u>24</u>	<u>22</u>	Similar to above, slight stratification
<u>25-27</u>		<u>5</u>	<u>6</u>	<u>5</u>	<u>6</u>		<u>7</u>	<u>24</u>	<u>22</u>	Similar to 5-6
										Bottom of Boring at 27 ft ✓

GENERAL REMARKS:

NA - Not Analyzed
 ND - Not Detected (sample < 1ppm)
 BSG - Below Surface Grade

PROJECT: 3102 Cranberry Hwy
 LOCATION: Wareham MA
 DRILLING CO: Sage
 EQUIPMENT: Geoprobe
 DRILLED BY: S. Perry

BORING NO. B-8
 PAGE 1 OF _____
 DATE STARTED: 11-3-20
 DATE FINISHED: 11-3-20
 SURFACE ELEVATION: _____

GROUNDWATER OBSERVATIONS

NOT ENCOUNTERED:
 At NE after 2 hours
 At NE after 31 hours

WELL _____ WELL SCREEN _____
 CASING _____
 TYPE: _____
 SIZE ID: _____

SAMPLING DEPTH (feet)	SAMPLE TYPE	HAMMER BLOWS ON SAMPLER (inches)				Strata Change (feet)	Sample ID			LITHOLOGY (Description of materials)
		0-6	6-12	12-18	18-24		No.	Pen	Rec	
0-2	SS	0	1	4	4		1	24	18	Surface: Topsoil - f/m sand, little silt, trace organic, dk brown
2-4		4	4	4	4	1.5	2	24	16	Subsoil - f/m sand, some silt, orange brown
5-7		4	5	5	5	2.5	3	24	16	sand - f/c, trace gravel, trace (+) silt, light brown
10-12		6	7	9	7		4	24	16	Similar to above
15-17		6	7	7	9		5	24	14	Sand - f/c, trace (+) silt, light brown, dry
20-22		5	5	5	5		6	24	20	Similar to above, trace silt
23-27		6	6	7	7		7	24	14	Gravelly Silty Sand - f/c, little gravel, little silt, grey brown wet
										Bottom of Boring at 27 ft

GENERAL REMARKS:

NA - Not Analyzed
 ND - Not Detected (sample < 1ppm)
 BSG - Below Surface Grade

SAGE Environmental, Inc.

GEOTECH BORING LOG

PROJECT: 3102 Cranberry Hwy
 LOCATION: Wareham MA
 DRILLING CO: Sage
 EQUIPMENT: Geoprobe
 DRILLED BY: S. Perry

BORING NO. B-9
 PAGE 1 OF _____
 DATE STARTED: 11-6-20
 DATE FINISHED: 11-6-20
 SURFACE ELEVATION: _____

GROUNDWATER OBSERVATIONS

NOT ENCOUNTERED:

At 23.8 after 2 hours
 At 23.8 after 16 hours

WELL

WELL

CASING

SCREEN

TYPE: _____

SIZE ID: _____

SAMPLING DEPTH (feet)	SAMPLE TYPE	HAMMER BLOWS ON SAMPLER (inches)				Strata Change (feet)	Sample ID			LITHOLOGY (Description of materials)
		0-6	6-12	12-18	18-24		No.	Pen	Rec	
0-2	SS	1	2	3	3	0.8	1	24	10	Surface: Topsoil - f/m sand, little silt, trace organic, dk brown
2-4		2	2	1	2		2	24	8	Subsoil - f/m sand, little silt, orange brown
5-7		3	3	3	4	2.5'	3	24	14	Silty sand, trace gravel, little silt, orange brown
10-12		5	4	6	5		4	24	15	Sand f/m, trace silt, light brown, dry
15-17		4	4	5	5		5	24	16	similar to above
20-22		6	5	7	9		6	24	18	similar to above
25-27		4	6	7	6		7	24	16	similar to above, wet
										Bottom of Boring at 27 ft

GENERAL REMARKS:

NA - Not Analyzed
 ND - Not Detected (sample < 1ppm)
 BGS - Below Surface Grade

PROJECT: 3102 Cranberry Hwy
 LOCATION: Wareham, MA
 DRILLING CO: Sage
 EQUIPMENT: Geoprobe
 DRILLED BY: S Perry

BORING NO. B-10
 PAGE 1 OF _____
 DATE STARTED: 11-6-20
 DATE FINISHED: 11-6-20
 SURFACE ELEVATION: _____

GROUNDWATER OBSERVATIONS

NOT ENCOUNTERED:
 At NE after 4 hours
 At _____ after _____ hours

WELL _____ WELL _____
 CASING _____ SCREEN _____

TYPE: _____
 SIZE ID: _____

SAMPLING DEPTH (feet)	SAMPLE TYPE	HAMMER BLOWS ON SAMPLER (Inches)				Strata Change (feet)	Sample ID			LITHOLOGY (Description of materials)
		0-6	6-12	12-18	18-24		No.	Pen	Rec	
0-2		1	1	1	2	1	24	14	Surface: Topsoil - flm Sand, little silt, trace organic, dk brown	
2-4		3	2	2	3	2	24	18	Sand - flm, trace silt, stratified, light brown	
5-7		6	8	9	11	3	24	14	Sand - flc, little Gravel trace silt, light brown	
10-12		11	13	16	19	4	24	18	Similar to above, light grey brown	
15-17		8	9	8	9	5	24	18	sand - flc, trace Gravel trace silt, light brown	
20-22		6	10	10	14	6	24	14	Gravelly Silty Sand - flc little Gravel, little silt grey brown	
									Bottom of Boring at 22A	

GENERAL REMARKS:

NA - Not Analyzed
 ND - Not Detected (sample < 1ppm)
 BSG - Below Surface Grade

SAGE Environmental, Inc.

GEOTECH BORING LOG

PROJECT: 3102 Cranberry Hwy
 LOCATION: Wareham MA
 DRILLING CO: Sage
 EQUIPMENT: Geoprobe
 DRILLED BY: S. Perry

BORING NO. B-11
 PAGE 1 OF
 DATE STARTED: 11-6-20
 DATE FINISHED: 11-6-20
 SURFACE ELEVATION:

GROUNDWATER OBSERVATIONS

NOT ENCOUNTERED:

At 19.2 after 0.1 hours
 At 19.4 after 26 hours

WELL CASING
 WELL SCREEN

TYPE:
 SIZE ID:

SAMPLING DEPTH (feet)	SAMPLE TYPE	HAMMER BLOWS ON SAMPLER (inches)				Strata Change (feet)	Sample ID			LITHOLOGY (Description of materials)
		0-6	6-12	12-18	18-24		No.	Pen	Rec	
0-2	SS	0	1	0	1		1	24	8	Surface: Topsoil - f/m sand little silt, trace organic, dk brown
						0.7				Subsoil - f/m sand, little silt, light orange brown, dry
						1.5				
2-4		1	2	2	3		2	24	16	Sand - f/m, trace silt, light brown
5-7		2	3	3	4		3	24	12	Sand - f/m, trace gravel, trace silt, light brown
10-12		9	11	12	13		4	24	18	Similar to above, stratified.
15-17		5	4	4	5		5	24	19	Sand - f/m, trace silt, light brown, stratified
20-22		2	4	4	6		6	24	10	Similar to S-3, wet
25-27		5	11	17	16		7	24	12	Similar to above, wet
30-32		8	10	9	10		8	24	10	Sand - f/m, trace silt, light grey brown
35-37		8	10	11	12		9	24	9	Similar to above.
40-42		7	11	14	13		10	24	8	Similar to above
45-47		5	7	11	12		11	24	8	Similar to above
50-52		14	17	23	25		12	24	10	Silty sand - f/c, trace (G) gravel, little silt, brown.
55-57		17	21	25	27		13	24	8	Gravelly Silty Sand - f/c little gravel, little silt, grey brown
										Bottom of Boring At 57ft

GENERAL REMARKS:

NA - Not Analyzed
 ND - Not Detected (sample < 1 ppm)
 BGS - Below Surface Gravel

SAGE Environmental, Inc.

GEOTECH BORING LOG

PROJECT: 3102 Cranberry Hwy
 LOCATION: Wareham, MA
 DRILLING CO: Sage
 EQUIPMENT: Geoprobe
 DRILLED BY: S. Perry

BORING NO. B-12
 PAGE 1 OF _____
 DATE STARTED: 11-5-20
 DATE FINISHED: 11-5-20
 SURFACE ELEVATION: _____

GROUNDWATER OBSERVATIONS

NOT ENCOUNTERED:

At 18.5 after 0.1 hours
 At _____ after _____ hours

WELL

WELL

CASING

SCREEN

TYPE: _____

SIZE ID: _____

SAMPLING DEPTH (feet)	SAMPLE TYPE	HAMMER BLOWS ON SAMPLER (inches)				Strata Change (feet)	Sample ID			LITHOLOGY (Description of materials)
		0-6	6-12	12-18	18-24		No.	Pen	Rec	
0-2	SS	1	1	1	2	0.8	1	24	14	Surface: Topsoil - f/m Sand Some silt, trace organic - dk brown Subsoil - f/m Sand, some silt, orange brown
2-4		4	2	2	3	1.8	2	24	16	Sand - f/c, trace Gravel, trace silt, stratified light orange brown
5-7		5	5	7	8		3	24	14	Similar to above, light brown, dry
10-12		5	9	9	11		4	24	14	Sand - f/m, trace silt light brown to grey
15-17		6	5	6	6		5	24	18	brown dry Sand - f/m, trace silt light brown, dry
20-22		4	4	4	4		6	24	6	Sand - f/c, trace Gravel, trace (+) silt, light brown, wet
25-27		5	6	6	7		7	24	6	Gravelly Silty Sand - f/c little Gravel, little silt light grey brown.
										Bottom of boring at 27ft

GENERAL REMARKS:

BA - Not Analyzed
 ND - Not Detected (Sample 1 Only)
 SG - Below Surface Gravel

SAGE Environmental, Inc.

GEOTECH BORING LOG

PROJECT: 3102 Cranberry Hwy
 LOCATION: Wareham, MA
 DRILLING CO: Sage
 EQUIPMENT: Geoprobe
 DRILLED BY: S. Perry

BORING NO. B-13
 PAGE 1 OF _____
 DATE STARTED: 11-5-20
 DATE FINISHED: 11-5-20
 SURFACE ELEVATION: _____

GROUNDWATER OBSERVATIONS

NOT ENCOUNTERED:

At 19 after 18 hours
 At _____ after _____ hours

WELL

WELL

CASING

SCREEN

TYPE: _____

SIZE ID: _____

SAMPLING DEPTH (feet)	SAMPLE TYPE	HAMMER BLOWS ON SAMPLER (inches)				Strata Change (feet)	Sample ID			LITHOLOGY (Description of materials)
		0-6	6-12	12-18	18-24		No.	Pen	Rec	
0-2	SS	2	2	2	2	1.3	1	24	8	Surface: Topsoil - f/m Sand little silt, trace organic NK brown
						2				subsoil - f/m Sand, little (4) silt, light orange brown
2-4		4	5	7	6		2	24	16	Sand - f/c, trace silt, light brown, dry
5-7		5	7	9	11		3	24	16	Similar to above
10-12		7	13	11	10		4	24	14	Sand - f/c, little Gravel trace silt, light brown, dry
15-17		6	12	12	13		5	24	10	Gravelly Silty Sand - f/c little Gravel, little silt.
25-27		8	10	14	14		6	24	10	Similar to above, wet
										Bottom of Boring at 27 ft

GENERAL REMARKS:

NA - Not Analyzed
 ND - Not Detected (sample < 1ppm)
 BSG - Below Surface Grade

SAGE Environmental, Inc.

GEOTECH BORING LOG

PROJECT: 3102 Cranberry Hwy
 LOCATION: Wareham, MA
 DRILLING CO: Sage
 EQUIPMENT: Geoprobe
 DRILLED BY: S. Perry

BORING NO. B-14
 PAGE 1 OF _____
 DATE STARTED: 11-5-20
 DATE FINISHED: 11-5-20
 SURFACE ELEVATION: _____

GROUNDWATER OBSERVATIONS

NOT ENCOUNTERED: 18.5
 At _____ after 0.1 hours
 At 18.6 after 12 hours

WELL CASING TYPE: _____
 WELL SCREEN SIZE ID: _____

SAMPLING DEPTH (feet)	SAMPLE TYPE	HAMMER BLOWS ON SAMPLER (inches)				Strata Change (feet)	Sample ID			LITHOLOGY (Description of materials)
		0-6	6-12	12-18	18-24		No.	Pen	Rec	
0-2	SS	1	1	1	2	0.8	1	24	16	Surface: Topsoil - f/m little silt, trace organic black to dk brown Subsoil - f/m sand, little silt, orange brown
2-4		3	3	3	4	1.5	2	24	18	Sand - f/m, trace silt, light brown
5-7		4	4	5	7		3	24	16	Similar to above
10-12		3	5	6	6		4	24	16	Similar to above
15-17		8	7	7	7		5	24	16	Similar to above
20-22		4	5	8	8		6	24	14	Similar to above, wet
25-27		5	7	9	9		7	24	14	Similar to above little silt, wet
							BOTTOM OF BORING AT 27 FT			

GENERAL REMARKS:

NA - Not Analyzed
 ND - Not Detected (Sample < 2ppm)
 BFG - Below Surface Grade

**SECTION 00 5000
CONTRACTING FORMS AND SUPPLEMENTS**

PART 1 GENERAL

**1.01 CONTRACTOR IS RESPONSIBLE FOR OBTAINING A VALID LICENSE TO USE ALL
COPYRIGHTED DOCUMENTS SPECIFIED BUT NOT INCLUDED IN THE PROJECT MANUAL.**

1.02 AGREEMENT AND CONDITIONS OF THE CONTRACT

- A. The Agreement is based on AIA A101.
- B. The General Conditions are based on AIA A201
- C. The Supplementary conditions are TBD

1.03 FORMS

- A. Use the following forms for the specified purposes unless otherwise indicated elsewhere in Contract Documents.
- B. Bond Forms:
 - 1. Performance and Payment Bond Form: AIA A312.
- C. Post-Award Certificates and Other Forms:
 - 1. Application for Payment Forms: AIA G702 with AIA G703 (for Contractors).
- D. Clarification and Modification Forms:
 - 1. Architect's Supplemental Instructions Form: AIA G710.
 - 2. Construction Change Directive Form: AIA G714.
 - 3. Change Order Form: AIA G701.
- E. Closeout Forms:
 - 1. Certificate of Substantial Completion Form: AIA G704.

1.04 REFERENCE STANDARDS

- A. AIA A102 - Standard Form of Agreement Between Owner and Contractor where the basis of payment is the Cost of the Work Plus a Fee with a Guaranteed Maximum Price; 2007.
- B. AIA A312 - Performance Bond and Payment Bond; 2010.
- C. AIA G701 - Change Order; 2001.
- D. AIA G702 - Application and Certificate for Payment; 1992.
- E. AIA G703 - Continuation Sheet; 1992.
- F. AIA G704 - Certificate of Substantial Completion; 2000.
- G. AIA G710 - Architect's Supplemental Instructions; 1992.
- H. AIA G714 - Construction Change Directive; 2007.

END OF SECTION

**SECTION 01 1000
SUMMARY**

PART 1 GENERAL

1.01 PROJECT

- A. Project Name: Woodland Cove
- B. Owner Name: Dakota Partners.
- C. Architect's Name: Ed Wojcik Architect, Ltd..
- D. The Project consists of the New Construction of One residential 3 story structure of 27 Units, One 4 story residential structure of 36 Units, and One single story community building..

1.02 CONTRACT DESCRIPTION

- A. Contract Type: A single prime contract based on AIA A102 with GMP as described in Document 00 5200 - Agreement Form.

1.03 CONTRACTOR USE OF SITE AND PREMISES

- A. Construction Operations: Limited to areas noted on Drawings.
- B. Provide access to and from site as required by law and by Owner:
 - 1. Emergency Building Exits During Construction: Keep all exits required by code open during construction period; provide temporary exit signs if exit routes are temporarily altered.
 - 2. Do not obstruct roadways, sidewalks, or other public ways without permit.
- C. Time Restrictions:
 - 1. Contractor shall abide by local ordinances governing noisy activities. It is the contractor's responsibility to verify these ordinances..

1.04 WORK SEQUENCE

- A. Coordinate construction schedule and operations with Owner.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 2000
PRICE AND PAYMENT PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Procedures for preparation and submittal of applications for progress payments.
- B. Documentation of changes in Contract Price and Contract Time.
- C. Change procedures.
- D. Correlation of Contractor submittals based on changes.
- E. Procedures for preparation and submittal of application for final payment.

1.02 RELATED REQUIREMENTS

1.03 SCHEDULE OF VALUES

- A. Form to be used: AIA G703.
- B. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit draft to Architect for approval.
- C. Forms filled out by hand will not be accepted.
- D. Submit Schedule of Values in duplicate within 15 days after date of Owner-Contractor Agreement.
- E. Revise schedule to list approved Change Orders, with each Application For Payment.

1.04 APPLICATIONS FOR PROGRESS PAYMENTS

- A. Payment Criteria
 - 1. Payment Period: Submit at intervals stipulated in the Agreement.
 - 2. Form to be used: AIA G702 and G703.
 - 3. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit sample to Architect for approval.
 - 4. Forms filled out by hand will not be accepted.
 - 5. Execute certification by signature of authorized officer.
 - 6. Use data from approved Schedule of Values. Provide dollar value in each column for each line item for portion of work performed and for stored products.
 - 7. Submit Four copies of each Application for Payment.
 - 8. Include the following with the application:
 - a. Transmittal letter as specified for submittals in Section 01 3000.
 - b. Partial release of liens from major Subcontractors and vendors.
 - 9. When Architect requires substantiating information, submit data justifying dollar amounts in question. Provide one copy of data with cover letter for each copy of submittal. Show application number and date, and line item by number and description.

1.05 MODIFICATION PROCEDURES

- A. For minor changes not involving an adjustment to the Contract Price or Contract Time, Architect will issue instructions directly to Contractor.
- B. For other required changes, Architect will issue a document signed by Owner instructing Contractor to proceed with the change, for subsequent inclusion in a Change Order.
 - 1. The document will describe the required changes and will designate method of determining any change in Contract Price or Contract Time.
 - 2. Promptly execute the change.
- C. For changes for which advance pricing is desired, Architect will issue a document that includes a detailed description of a proposed change with supplementary or revised drawings and

specifications, a change in Contract Time for executing the change with a stipulation of any overtime work required and the period of time during which the requested price will be considered valid. Contractor shall prepare and submit a fixed price quotation within Five days.

- D. Computation of Change in Contract Amount: As specified in the Agreement and Conditions of the Contract.
 - 1. For change requested by Architect for work falling under a fixed price contract, the amount will be based on Contractor's price quotation.
 - 2. For change requested by Contractor, the amount will be based on the Contractor's request for a Change Order as approved by Architect.
 - 3. For pre-determined unit prices and quantities, the amount will be based on the fixed unit prices.
 - 4. For change ordered by Architect without a quotation from Contractor, the amount will be determined by Architect based on the Contractor's substantiation of costs as specified for Time and Material work.
- E. Substantiation of Costs: Provide full information required for evaluation.
 - 1. On request, provide the following data:
 - a. Quantities of products, labor, and equipment.
 - b. Taxes, insurance, and bonds.
 - c. Overhead and profit.
 - d. Justification for any change in Contract Time.
 - e. Credit for deletions from Contract, similarly documented.
- F. Execution of Change Orders: Architect will issue Change Orders for signatures of parties as provided in the Conditions of the Contract.
- G. After execution of Change Order, promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as a separate line item and adjust the Contract Price.
- H. Promptly revise progress schedules to reflect any change in Contract Time, revise sub-schedules to adjust times for other items of work affected by the change, and resubmit.
- I. Promptly enter changes in Project Record Documents.

1.06 APPLICATION FOR FINAL PAYMENT

- A. Prepare Application for Final Payment as specified for progress payments, identifying total adjusted Contract Price, previous payments, and sum remaining due.
- B. Application for Final Payment will not be considered until the following have been accomplished:
 - 1. All closeout procedures specified in Section 01 7000.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

**SECTION 01 2100
ALLOWANCES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Cash allowances.

1.02 CASH ALLOWANCES

- A. Costs Included in Cash Allowances: Cost of product to Contractor or subcontractor, less applicable trade discounts.

1.03 INSPECTING AND TESTING ALLOWANCES

- A. Costs Included in Inspecting and Testing Allowances: Cost of engaging an inspecting or testing agency; execution of inspecting and tests; and reporting results.

1.04 ALLOWANCES SCHEDULE

A. PROJECT ALLOWANCES

1. Section 10 1400- SIGNAGE: Include the stipulated sum of \$7500 for purchase and delivery of Interior Signage.
2. Section 31 2310 - EARTHWORK: Include the stipulated sum of \$10,000 for removal of Boulders (rocks 1 cy and larger) and other unsuitable soils/ debris.
3. Section 01500-Temporary Facilities and Controls: Include the stipulated sum of \$35,000 for Winter Conditions.
4. Section Landscaping: Include the stipulated sum of \$50,000 for installation of Base Landscaping Package.
5. Section Site Furnishings: Include the stipulated sum of \$10,000 for purchase and installation of a pre-fabricated bus shelter.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

**SECTION 01 2300
ALTERNATES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Description of Alternates.
- B. Procedures for pricing Alternates.
- C. Documentation of changes to Contract Price and Contract Time.

1.02 SCHEDULE OF ALTERNATES

A. CIVIL ALTERNATES -

- 1. Alternate # CIV-1 - Provide concrete sidewalks at site areas depicted on the drawings.
 - a. Base Bid: - Provide bituminous paving sidewalks at site areas depicted on the drawings.
- 2. Alternate # CIV-2 - Install granite curbing where there are sidewalks and Cape Cod Berms as shown on the plans.
 - a. Base Bid - Extruded concrete curb at sidewalks and Cape Cod berm in other areas.
- 3. Alternate # CIV-3 - Provide site irrigation as a design build contract.
 - a. Base Bid - No irrigation.
- 4. Alternate # CIV-4 - Construct enhanced landscape plan as depicted on the drawings.
 - a. Base Bid - Construct permitted landscape design as depicted on the drawings.
- 5. Alternate # CIV-5 - Provide concrete unit pavers at Community Building patio.
 - a. Base Bid - Stamped concrete.

B. ARCHITECTURAL ALTERNATES

- 1. Alternate # ARC-1 - Pre-fabricated stone panels SECTION 04 4253 as indicated on the drawings (First Floor, Exterior Elevations)
 - a. Base bid - Fiber Cement Siding SECTION 074646
- 2. Alternate # ARC-2 Lobby 102; B2 Wood Wall Base SECTION 062000
 - a. Base bid - B1 Resilient Base SECTION 096500
- 3. Alternate # ARC-3 Metal Stud Framing at Non-Loadbearing Interior Partitions
 - a. Base bid - Wood Studs per SECTION 06 1000
- 4. Alternate # ARC-4 LVT-3 Flooring at Unit Kitchens
 - a. Base bid - Sheet Vinyl SV-1
- 5. Alternate # ARC-5 LVT-3 Flooring at Unit Living/Dining Areas at 2nd,3rd, and 4th floors.
 - a. Base bid - Carpet CPT-2
- 6. Alternate # ARC-6 LVT-3 Flooring at Unit Bedrooms
 - a. Base bid - Carpet CPT-2 at 2nd, 3rd, and 4th floors.
- 7. Alternate # ARC-7 TL-3 Tile Flooring & T-3A Base at Unit Bathrooms/Linen closets in bathrooms.
 - a. Base bid - Sheet Vinyl SV-1 Flooring & VB-2 Base
- 8. Alternate # ARC-8 Upper Cabinets at Residential Units to be 36" tall.
 - a. Base bid - Upper cabinets at residential units to be 30" tall.
- 9. Alternate # ARC-9 TL-1: Community Building; Tile backsplash at Community Room.
 - a. Base bid- Paint
- 10. Alternate # ARC-10 Community Building Doors 102, 115, 117, & 119. Provide 45 min. rated Flush Wood Door painted (Type WD-4) with 45 min.full lite fire rated glazing and 45 min. rated HM frame, painted.
 - a. Base Bid - Doors as scheduled.

C. SECURITY ALTERNATES-SEE DRAWINGS

1. Alternate # SEC-1 Add card readers to Laundry Room and Mailroom Doors and add (25) total Cameras in locations depicted on the drawings.
 - a. Base bid: No card readers at Laundry Room and Mailroom Doors. No cameras.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 2500
SUBSTITUTION PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Procedural requirements for proposed substitutions.

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 coordinate installation and make changes to other work that may be required for the work to be complete, with no additional cost to Owner.
 - 4. 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.
- C. Content: Include information necessary for tracking the status of each Substitution Request, and information necessary to provide an actionable response.
- D. Limit each request to a single proposed substitution item.

3.02 SUBSTITUTION PROCEDURES DURING PROCUREMENT

- A. Owner will consider requests for substitutions only if submitted at least 10 days prior to the date for receipt of bids.

3.03 SUBSTITUTION PROCEDURES DURING CONSTRUCTION

- A. Submit request for Substitution for Cause within 14 days of 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.

3.04 RESOLUTION

3.05 ACCEPTANCE

END OF SECTION

SECTION 01 3000
ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Electronic document submittal service.
- B. Preconstruction meeting.
- C. Site mobilization meeting.
- D. Progress meetings.
- E. Construction progress schedule.
- F. Submittals for review, information, and project closeout.
- G. Number of copies of submittals.
- H. Submittal procedures.

1.02 RELATED REQUIREMENTS

- A. Section 00 7200 - General Conditions: Dates for applications for payment.
- B. Section 01 7800 - Closeout Submittals: Project record documents; operation and maintenance data; warranties and bonds.

1.03 PROJECT COORDINATOR

- A. Project Coordinator: Construction Manager.
- B. Cooperate with the Project Coordinator in allocation of mobilization areas of site; for field offices and sheds, for access, traffic, and parking facilities.
- C. During construction, coordinate use of site and facilities through the Project Coordinator.
- D. Comply with Project Coordinator's procedures for intra-project communications; submittals, reports and records, schedules, coordination drawings, and recommendations; and resolution of ambiguities and conflicts.
- E. Comply with instructions of the Project Coordinator for use of temporary utilities and construction facilities. Responsibility for providing temporary utilities and construction facilities is identified in Section 01 1000 - Summary.
- F. Coordinate field engineering and layout work under instructions of the Project Coordinator.
- G. Make the following types of submittals to Architect through the Project Coordinator:
 - 1. Requests for Interpretation.
 - 2. Requests for substitution.
 - 3. Shop drawings, product data, and samples.
 - 4. Test and inspection reports.
 - 5. Manufacturer's instructions and field reports.
 - 6. Applications for payment and change order requests.
 - 7. Progress schedules.
 - 8. Coordination drawings.
 - 9. Closeout submittals.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PRECONSTRUCTION MEETING

- A. Owner will schedule a meeting after Notice of Award.
- B. Attendance Required:

1. Owner.
 2. Architect.
 3. Contractor.
- C. Agenda:
1. Execution of Owner-Contractor Agreement.
 2. Submission of executed bonds and insurance certificates.
 3. Distribution of Contract Documents.
 4. Submission of list of subcontractors, list of products, schedule of values, and progress schedule.
 5. Designation of personnel representing the parties to Contract, _____ and Architect.
 6. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
 7. Scheduling.
- D. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.02 SITE MOBILIZATION MEETING

- A. Owner will schedule meeting at the Project site prior to Contractor occupancy.
- B. Attendance Required:
1. Contractor.
 2. Owner.
 3. Architect.
 4. Contractor's superintendent.
 5. MA Housing and Community Development Representative.
- C. Agenda:
1. Use of premises by Owner and Contractor.
 2. Owner's requirements.
 3. Construction facilities and controls provided by Owner.
 4. Temporary utilities provided by Owner.
 5. Survey and building layout.
 6. Security and housekeeping procedures.
 7. Schedules.
 8. Application for payment procedures.
 9. Procedures for testing.
 10. Procedures for maintaining record documents.
 11. Requirements for start-up of equipment.
 12. Inspection and acceptance of equipment put into service during construction period.
- D. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.03 PROGRESS MEETINGS

- A. **Schedule and administer meetings throughout progress of the Work at maximum weekly intervals.**
- B. Make arrangements for meetings, prepare agenda with copies for participants, preside at meetings.
- C. Attendance Required:
1. Contractor.
 2. Owner.
 3. Architect.
 4. Contractor's superintendent.
 5. Major subcontractors.
- D. Agenda:

1. Review minutes of previous meetings.
2. Review of work progress.
3. Field observations, problems, and decisions.
4. Identification of problems that impede, or will impede, planned progress.
5. Review of submittals schedule and status of submittals.
6. Maintenance of progress schedule.
7. Corrective measures to regain projected schedules.
8. Planned progress during succeeding work period.
9. Maintenance of quality and work standards.
10. Effect of proposed changes on progress schedule and coordination.
11. Other business relating to work.

- E. **Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.**

3.04 CONSTRUCTION PROGRESS SCHEDULE

- A. If preliminary schedule requires revision after review, submit revised schedule within 10 days.
- B. Within 20 days after review of preliminary schedule, submit draft of proposed complete schedule for review.
 1. Include written certification that major contractors have reviewed and accepted proposed schedule.
- C. Within 10 days after joint review, submit complete schedule.
- D. Submit updated schedule with each Application for Payment.

3.05 SUBMITTALS FOR REVIEW

- A. When the following are specified in individual sections, submit them for review:
 1. Shop drawings.
 2. Samples for selection.
 3. Samples for verification.
- B. Submit to Architect for review for the limited purpose of checking for compliance with information given and the design concept expressed in Contract Documents.
- C. Samples will be reviewed for aesthetic, color, or finish selection.
- D. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below and for record documents purposes described in Section 01 7800 - Closeout Submittals.

3.06 SUBMITTALS FOR INFORMATION

- A. When the following are specified in individual sections, submit them for information:
 1. Design data.
 2. Certificates.
 3. Test reports.
 4. Inspection reports.
 5. Manufacturer's instructions.
 6. Manufacturer's field reports.
 7. Other types indicated.
- B. Submit for Architect's knowledge as contract administrator or for Owner.

3.07 SUBMITTALS FOR PROJECT CLOSEOUT

- A. Submit Correction Punch List for Substantial Completion.
- B. Submit Final Correction Punch List for Substantial Completion.

- C. When the following are specified in individual sections, submit them at project closeout in compliance with requirements of Section 01 7800 - Closeout Submittals:
 - 1. Project record documents.
 - 2. Operation and maintenance data.
 - 3. Warranties.
 - 4. Bonds.
 - 5. Other types as indicated.
- D. Submit for Owner's benefit during and after project completion.

3.08 NUMBER OF COPIES OF SUBMITTALS

- A. Electronic Documents: Submit one electronic copy in PDF format; an electronically-marked up file will be returned. Create PDFs at native size and right-side up; illegible files will be rejected.
- B. Samples: Submit the number specified in individual specification sections; one of which will be retained by Architect.
 - 1. After review, produce duplicates.
 - 2. Retained samples will not be returned to Contractor unless specifically so stated.

3.09 SUBMITTAL PROCEDURES

- A. General Requirements:
- B. Transmit each submittal with approved form.

END OF SECTION

**SECTION 01 3216
CONSTRUCTION PROGRESS SCHEDULE**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Preliminary schedule.
- B. Construction progress schedule, bar chart type.

1.02 REFERENCE STANDARDS

- A. AGC (CPSM) - Construction Planning and Scheduling Manual; 2004.
- B. M-H (CPM) - CPM in Construction Management - Project Management with CPM; O'Brien; 2006.

1.03 SUBMITTALS

- A. Within 10 days after date of Agreement, submit preliminary schedule.
- B. If preliminary schedule requires revision after review, submit revised schedule within 10 days.
- C. Within 20 days after review of preliminary schedule, submit draft of proposed complete schedule for review.
- D. Within 10 days after joint review, submit complete schedule.
- E. Submit updated schedule with each Application for Payment.

1.04 QUALITY ASSURANCE

- A. Scheduler: Contractor's personnel or specialist Consultant specializing in CPM scheduling with one years minimum experience in scheduling construction work of a complexity comparable to this Project, and having use of computer facilities capable of delivering a detailed graphic printout within 48 hours of request.

1.05 SCHEDULE FORMAT

- A. Listings: In chronological order according to the start date for each activity. Identify each activity with the applicable specification section number.
- B. Sheet Size: Multiples of 8-1/2 x 11 inches.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PRELIMINARY SCHEDULE

- A. Prepare preliminary schedule in the form of a horizontal bar chart.

3.02 CONTENT

- A. Show complete sequence of construction by activity, with dates for beginning and completion of each element of construction.
- B. Show accumulated percentage of completion of each item, and total percentage of Work completed, as of the first day of each month.
- C. Provide legend for symbols and abbreviations used.

3.03 BAR CHARTS

- A. Include a separate bar for each major portion of Work or operation.
- B. Identify the first work day of each week.

3.04 UPDATING SCHEDULE

- A. Maintain schedules to record actual start and finish dates of completed activities.

- B. Indicate progress of each activity to date of revision, with projected completion date of each activity.
- C. Annotate diagrams to graphically depict current status of Work.
- D. Identify activities modified since previous submittal, major changes in Work, and other identifiable changes.
- E. Indicate changes required to maintain Date of Substantial Completion.
- F. Submit reports required to support recommended changes.

END OF SECTION

SECTION 01 4000
QUALITY REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Submittals.
- B. References and standards.
- C. Testing and inspection agencies and services.
- D. Control of installation.
- E. Mock-ups.
- F. Defect Assessment.

1.02 REFERENCE STANDARDS

- A. ASTM C1021 - Standard Practice for Laboratories Engaged in Testing of Building Sealants; 2008 (Reapproved 2014).
- B. ASTM C1077 - Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation; 2014.
- C. ASTM C1093 - Standard Practice for Accreditation of Testing Agencies for Masonry; 2013.
- D. ASTM D3740 - Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction; 2012a.
- E. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection and/or Testing; 2014a.
- F. ASTM E543 - Standard Specification for Agencies Performing Nondestructive Testing; 2013.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Test Reports: After each test/inspection, promptly submit two copies of report to Architect and to Contractor.
 - 1. Include:
 - a. Date issued.
 - b. Project title and number.
 - c. Name of inspector.
 - d. Date and time of sampling or inspection.
 - e. Identification of product and specifications section.
 - f. Location in the Project.
 - g. Type of test/inspection.
 - h. Date of test/inspection.
 - i. Results of test/inspection.
 - j. Compliance with Contract Documents.
 - k. When requested by Architect, provide interpretation of results.
 - 2. Test report submittals are for Architect's knowledge as contract administrator for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents, or for Owner's information.
- C. Certificates: When specified in individual specification sections, submit certification by the manufacturer and Contractor or installation/application subcontractor to Architect, in quantities specified for Product Data.
 - 1. Indicate material or product complies with or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.

2. Certificates may be recent or previous test results on material or product, but must be acceptable to Architect.
- D. Manufacturer's Instructions: When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, for the Owner's information. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.
- E. Manufacturer's Field Reports: Submit reports for Architect's benefit as contract administrator or for Owner.
 1. Submit report in duplicate within 30 days of observation to Architect for information.
 2. Submit for information for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents.

1.04 REFERENCES AND STANDARDS

- A. For products and workmanship specified by reference to a document or documents not included in the Project Manual, also referred to as reference standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- B. Comply with reference standard of date of issue current on date of Contract Documents, except where a specific date is established by applicable code.
- C. Obtain copies of standards where required by product specification sections.
- D. Maintain copy at project site during submittals, planning, and progress of the specific work, until Substantial Completion.
- E. Should specified reference standards conflict with Contract Documents, request clarification from Architect before proceeding.
- F. Neither the contractual relationships, duties, or responsibilities of the parties in Contract nor those of Architect shall be altered from Contract Documents by mention or inference otherwise in any reference document.

1.05 TESTING AND INSPECTION AGENCIES AND SERVICES

- A. Owner will employ and pay for services of an independent testing agency to perform specified testing.
- B. Employment of agency in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.
- C. Contractor Employed Agency:
 1. Testing agency: Comply with requirements of ASTM E329, ASTM E543, ASTM C1021, ASTM C1077, ASTM C1093, and ASTM D3740.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 CONTROL OF INSTALLATION

- A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality.
- B. Comply with manufacturers' instructions, including each step in sequence.
- C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect before proceeding.
- D. Comply with specified standards as minimum quality for the work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Have work performed by persons qualified to produce required and specified quality.

- F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.
- G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.

3.02 MOCK-UPS

- A. Tests shall be performed under provisions identified in this section and identified in the respective product specification sections.
- B. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.
- C. Architect will use accepted mock-ups as a comparison standard for the remaining Work.
- D. Where mock-up has been accepted by Architect and is specified in product specification sections to be removed, protect mock-up throughout construction, remove mock-up and clear area when directed to do so by Architect.

3.03 TESTING AND INSPECTION

- A. See individual specification sections for testing required.
- B. Testing Agency Duties:
 - 1. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
 - 2. Perform specified sampling and testing of products in accordance with specified standards.
 - 3. Ascertain compliance of materials and mixes with requirements of Contract Documents.
 - 4. Promptly notify Architect and Contractor of observed irregularities or non-compliance of Work or products.
 - 5. Perform additional tests and inspections required by Architect.
 - 6. Submit reports of all tests/inspections specified.
- C. Limits on Testing/Inspection Agency Authority:
 - 1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
 - 2. Agency may not approve or accept any portion of the Work.
 - 3. Agency may not assume any duties of Contractor.
 - 4. Agency has no authority to stop the Work.
- D. Contractor Responsibilities:
 - 1. Deliver to agency at designated location, adequate samples of materials proposed to be used that require testing, along with proposed mix designs.
 - 2. Cooperate with laboratory personnel, and provide access to the Work and to manufacturers' facilities.
 - 3. Provide incidental labor and facilities:
 - a. To provide access to Work to be tested/inspected.
 - b. To obtain and handle samples at the site or at source of Products to be tested/inspected.
 - c. To facilitate tests/inspections.
 - d. To provide storage and curing of test samples.
 - 4. Notify Architect and laboratory 24 hours prior to expected time for operations requiring testing/inspection services.
 - 5. Employ services of an independent qualified testing laboratory and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
 - 6. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.

- E. Re-testing required because of non-compliance with specified requirements shall be performed by the same agency on instructions by Architect.
- F. Re-testing required because of non-compliance with specified requirements shall be paid for by Contractor.

3.04 MANUFACTURERS' FIELD SERVICES

- A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship start-up of equipment, test, adjust and balance of equipment as applicable, and to initiate instructions when necessary.
- B. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

3.05 DEFECT ASSESSMENT

- A. Replace Work or portions of the Work not complying with specified requirements.
- B. If, in the opinion of Architect, upon consultation with the Owner it is not practical to remove and replace the Work, Architect will direct an appropriate remedy or adjust payment.

END OF SECTION

SECTION 01 4100
REGULATORY REQUIREMENTS

PART 1 GENERAL

1.01 SUMMARY OF REFERENCE STANDARDS

- A. Federal Codes
 - 1. Federal Fair Housing Amendments Act
 - 2. Section of the Federal Rehabilitation Act
 - 3. Uniform Federal Accessibility Standards
 - 4. Americans With Disabilities Act
 - 5. U.S. Department of Energy, Energy Star
 - 6. Federal HUD Section 8 Housing Quality Standards
 - 7. Clean Air and Water Acts
 - 8. EPA Watersense
 - 9. 92.251 Property Standards
- B. Massachusetts Codes
 - 1. MA State Building Code and Related Codes
 - a. Fuel Gas and Plumbing
 - b. National Electrical Code
 - c. MA Fire Regulations/National Fire Protection Association
 - d. MA Architectural Access Board Regulations
 - e. MA Stretch Code and/or applicable IECC
 - f. MA Department of Public Health/State Sanitary Code
 - 2. Department of Environmental Protection
 - 3. State HOME, HSF, FCF, HTF, AHTF, CBH, CIPF, CATNHP and LIHTC Programs
- C. Passive House Regulations
 - 1. PHIUS + Core

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 5000
TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Temporary utilities.
- B. Temporary telecommunications services.
- C. Temporary sanitary facilities.
- D. Temporary Controls: Barriers, enclosures, and fencing.
- E. Security requirements.
- F. Vehicular access and parking.
- G. Waste removal facilities and services.
- H. Field offices.

1.02 TEMPORARY UTILITIES

- A. Contractor will provide the following including utility and fuel charges:
 - 1. Electrical power , consisting of New temporary power pole as required..
 - 2. Water supply, consisting of temporary connection with metering to public water supply..
 - 3. Heat to the building during winter conditions
 - a. Maintain minimum ambient temperature of 50 degrees F in areas where construction is in progress, unless indicated otherwise in specifications.

1.03 TEMPORARY LIGHTING FOR CONSTRUCTION PURPOSES

- A. Provide and maintain LED, compact fluorescent, or high-intensity discharge lighting as suitable for the application for construction operations in accordance with requirements of 29 CFR 1926 and authorities having jurisdiction.

1.04 TELECOMMUNICATIONS SERVICES

- A. Provide, maintain, and pay for telecommunications services to field office at time of project mobilization. Contractor shall provide to Owner and Architect the name of a contact person and telephone # for 24 hour access related to on site emergency issues.

1.05 TEMPORARY SANITARY FACILITIES

- A. Provide and maintain required facilities and enclosures. Provide at time of project mobilization.
- B. Maintain daily in clean and sanitary condition.

1.06 BARRIERS

- A. Provide barriers to prevent unauthorized entry to construction areas, to prevent access to areas that could be hazardous to workers or the public, to allow for owner's use of site and to protect existing facilities and adjacent properties from damage from construction operations and demolition.
- B. Provide protection for plants designated to remain. Replace damaged plants.
- C. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

1.07 SMOKING

- A. **Smoking is not permitted on the work site.**
- B. Post signs and educate subcontractors to the no smoking policy.

1.08 FENCING

- A. Construction: Contractor's option.

- B. Provide 6 foot high fence around construction site; equip with vehicular and pedestrian gates with locks.

1.09 EXTERIOR ENCLOSURES

- A. Provide temporary insulated weather tight closure of exterior openings to accommodate acceptable working conditions and protection for Products, to allow for temporary heating and maintenance of required ambient temperatures identified in individual specification sections, and to prevent entry of unauthorized persons. Provide access doors with self-closing hardware and locks.

1.10 VEHICULAR ACCESS AND PARKING

- A. Comply with regulations relating to use of streets and sidewalks, access to emergency facilities, and access for emergency vehicles.
- B. Coordinate access and haul routes with governing authorities and Owner.
- C. Provide and maintain access to fire hydrants, free of obstructions.
- D. Provide means of removing mud from vehicle wheels before entering streets.

1.11 WASTE REMOVAL

- A. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.
- B. Provide containers with lids. Remove trash from site periodically.
- C. If materials to be recycled or re-used on the project must be stored on-site, provide suitable non-combustible containers; locate containers holding flammable material outside the structure unless otherwise approved by the authorities having jurisdiction.
- D. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

1.12 PROJECT SIGNS - SEE SECTION 01 5813

1.13 FIELD OFFICES

- A. Provide space for Project meetings, with table and chairs to accommodate 8 persons.

1.14 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

- A. Remove temporary utilities, equipment, facilities, materials, prior to Date of Substantial Completion inspection.
- B. Remove underground installations to a minimum depth of 2 feet. Grade site as indicated.
- C. Clean and repair damage caused by installation or use of temporary work.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 5813
TEMPORARY PROJECT SIGNAGE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Project identification sign.
- B. Project informational signs.

1.02 RELATED REQUIREMENTS

- A. Section 01 1000 - Summary: Responsibility to provide signs.

1.03 REFERENCE STANDARDS

- A. FHWA (SHS) - Standard Highway Signs; Federal Highway Administration; 2004.

1.04 QUALITY ASSURANCE

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Shop Drawing: Show content, layout, lettering, color, foundation, structure, sizes and grades of members.

PART 2 PRODUCTS

2.01 SIGN MATERIALS

- A. Structure and Framing: New, wood, structurally adequate.
- B. Sign Surfaces: Exterior grade plywood with medium density overlay, minimum 3/4 inch thick, standard large sizes to minimize joints.
- C. Rough Hardware: Galvanized.
- D. Paint and Primers: Exterior quality, two coats; sign background of white color.
- E. Lettering: Pre-cut vinyl self-adhesive products, white.

2.02 PROJECT IDENTIFICATION SIGN

- A. One painted sign, 32 sq ft area, bottom 4 feet above ground.
- B. Content: TBD
- C. Lettering: Standard Alphabet Series C, as specified in FHWA (SHS).

2.03 PROJECT INFORMATIONAL SIGNS

- A. Provide at each field office, storage shed, and directional signs to direct traffic into and within site. Relocate as Work progress requires.
- B. **Provide "No Smoking" signs at each building entrance.**

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install project identification sign within 30 days after date fixed by Notice to Proceed.
- B. Erect at designated location.
- C. Install sign surface plumb and level, with butt joints. Anchor securely.

3.02 MAINTENANCE

- A. Maintain signs and supports clean, repair deterioration and damage.

3.03 REMOVAL

- A. Remove signs, framing, supports, and foundations at completion of Project and restore the area.

END OF SECTION

SECTION 01 6000
PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. General product requirements.
- B. Re-use of existing products.
- C. Transportation, handling, storage and protection.
- D. Product option requirements.
- E. Substitution limitations.

1.02 RELATED REQUIREMENTS

- A. Section 01 2500 - Substitution Procedures: Substitutions made during procurement and/or construction phases.
- B. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions: Requirements for VOC-restricted product categories.
- C. Section 01 7419 - Construction Waste Management and Disposal: Waste disposal requirements potentially affecting product selection, packaging and substitutions.

1.03 REFERENCE STANDARDS

- A. 16 CFR 260.13 - Guides for the Use of Environmental Marketing Claims; Federal Trade Commission; Recycled Content; Current Edition.
- B. CAN/CSA Z809 - National Standard for Sustainable Forest Management; CSA International Inc; 2008.
- C. EN 15804 - Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products; 2012.
- D. GreenScreen (LIST) - GreenScreen for Safer Chemicals List Translator; Clean Production Action; www.greenscreenchemicals.org.
- E. GreenScreen (METH) - GreenScreen for Safer Chemicals Method v1.2; Clean Production Action; www.greenscreenchemicals.org.
- F. ISO 14025 - Environmental labels and declarations -- Type III environmental declarations -- Principles and procedures; 2006.
- G. ISO 14040 - Environmental management -- Life cycle assessment -- Principles and framework; 2006.
- H. ISO 14044 - Environmental management -- Life cycle assessment -- Requirements and guidelines; 2006.
- I. ISO 21930 - Sustainability in building construction -- Environmental declaration of building products; 2007.

1.04 SUBMITTALS

- A. Product Data Submittals: Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.
- B. Shop Drawing Submittals: Prepared specifically for this Project; indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- C. Sample Submittals: Illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.

1. For selection from standard finishes, submit samples of the full range of the manufacturer's standard colors, textures, and patterns.

1.05 QUALITY ASSURANCE

- A. Environmental Product Declaration (EPD): Publicly available, critically reviewed life cycle analysis having at least a cradle-to-gate scope.
 1. Good: Product-specific; compliant with ISO 14044.
 2. Better: Industry-wide, generic; compliant with ISO 21930, or with ISO 14044, ISO 14040, ISO 14025, and EN 15804; Type III third-party certification with external verification, in which the manufacturer is recognized as the program operator.
 3. Best: Commercial-product-specific; compliant with ISO 21930, or with ISO 14044, ISO 14040, ISO 14025, and EN 15804; Type III third-party certification with external verification, in which the manufacturer is recognized as the program operator.
 4. Where demonstration of impact reduction below industry average is required, submit both industry-wide and commercial-product-specific declarations; or submit at least 5 declarations for products of the same type by other manufacturers in the same industry.
- B. GreenScreen Chemical Hazard Analysis: Ingredients of 100 parts-per-million or greater evaluated using GreenScreen (METH).
 1. Good: GreenScreen (LIST) evaluation to identify Benchmark 1 hazards; a Health Product Declaration includes this information.
 2. Better: GreenScreen Full Assessment.
 3. Best: GreenScreen Full Assessment by GreenScreen Licensed Profiler.
 4. Acceptable Evidence: GreenScreen report.
- C. Recycled Content: Determine percentage of post-consumer and pre-consumer (post-industrial) content separately, using the guidelines contained in 16 CFR 260.13.
 1. Previously used, reused, refurbished, and salvaged products are not considered recycled.
 2. Wood fabricated from timber abandoned in transit to original mill is considered reused, not recycled.
 3. Determine percentage of recycled content of any item by dividing the weight of recycled content in the item by the total weight of materials in the item.
 4. Determine value of recycled content of each item separately, by multiplying the content percentage by the value of the item.
 5. Acceptable Evidence:
 - a. For percentage of recycled content, information from manufacturer.
 - b. For cost, Contractor's cost data.
- D. Sustainably Harvested Wood: Solid wood, wood chips, and wood fiber certified or labeled by an organization accredited by one of the following:
 1. American Forest Foundation, The American Tree Farm System; refer to <http://www.treefarmssystem.org>.
 2. Canadian Sustainable Forest Management System, under CAN/CSA Z809; refer to <http://www.csasfmforests.ca>.
 3. The Forest Stewardship Council, The Principles for Natural Forest Management; for Canada visit <http://www.fscscanada.org>, for the USA visit <http://www.fscus.org>.
 4. Sustainable Forestry Board, under The Sustainable Forestry Initiative® of the American Forest & Paper Association; refer to <http://www.afandpa.org>.
 5. Acceptable Evidence: Copies of invoices bearing the certifying organization's certification numbers.

PART 2 PRODUCTS

2.01 EXISTING PRODUCTS

- A. Do not use materials and equipment removed from existing premises unless specifically required or permitted by Contract Documents.

- B. Unforeseen historic items encountered remain the property of the Owner; notify Owner promptly upon discovery; protect, remove, handle, and store as directed by Owner.

2.02 NEW PRODUCTS

- A. Provide new products unless specifically required or permitted by Contract Documents.
- B. Use of products having any of the following characteristics is not permitted:
 - 1. Made outside the United States, its territories, Canada, or Mexico.
 - 2. Made using or containing CFC's or HCFC's.
 - 3. Made of wood from newly cut old growth timber.
- C. Where other criteria are met, Contractor shall give preference to products that:
 - 1. If used on interior, have lower emissions, as defined in Section 01 6116.
 - 2. If wet-applied, have lower VOC content, as defined in Section 01 6116.
 - 3. Have a published GreenScreen Chemical Hazard Analysis.

2.03 PRODUCT OPTIONS

- A. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.
- B. Products Specified by Naming One or More Manufacturers: Use a product of one of the manufacturers named and meeting specifications, no options or substitutions allowed.
- C. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.

PART 3 EXECUTION

3.01 SUBSTITUTION LIMITATIONS

- A. See Section 01 2500 - Substitution Procedures.

3.02 TRANSPORTATION AND HANDLING

- A. Package products for shipment in manner to prevent damage; for equipment, package to avoid loss of factory calibration.
- B. If special precautions are required, attach instructions prominently and legibly on outside of packaging.
- C. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.
- D. Transport and handle products in accordance with manufacturer's instructions.
- E. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.
- F. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.
- G. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage, and to minimize handling.
- H. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

3.03 STORAGE AND PROTECTION

- A. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication. See Section 01 7419.
- B. Store and protect products in accordance with manufacturers' instructions.
- C. Store with seals and labels intact and legible.

- D. Store sensitive products in weathertight, climate-controlled enclosures in an environment favorable to product.
- E. For exterior storage of fabricated products, place on sloped supports above ground.
- F. Provide off-site storage and protection when site does not permit on-site storage or protection.
- G. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.
- H. Comply with manufacturer's warranty conditions, if any.
- I. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- J. Prevent contact with material that may cause corrosion, discoloration, or staining.
- K. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- L. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

END OF SECTION

SECTION 01 6116

VOLATILE ORGANIC COMPOUND (VOC) CONTENT RESTRICTIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Requirement for installer certification that they did not use any non-compliant products.
- B. VOC restrictions for product categories listed below under "DEFINITIONS."
- C. All products of each category that are installed in the project must comply; Owner's project goals do not allow for partial compliance.

1.02 DEFINITIONS

- A. VOC-Restricted Products: All products of each of the following categories when installed or applied on-site in the building interior:
 - 1. Adhesives, sealants, and sealer coatings.
 - 2. Carpet.
 - 3. Carpet cushion.
 - 4. Carpet tile.
 - 5. Resilient floor coverings.
 - 6. Paints and coatings.
 - 7. Insulation.
- B. Interior of Building: Anywhere inside the exterior weather barrier.
- C. Adhesives: All gunnable, trowelable, liquid-applied, and aerosol adhesives, whether specified or not; including flooring adhesives, resilient base adhesives, and pipe jointing adhesives.
- D. Sealants: All gunnable, trowelable, and liquid-applied joint sealants and sealant primers, whether specified or not; including firestopping sealants and duct joint sealers.

1.03 REFERENCE STANDARDS

- A. CAL (CHPS LEM) - Low-Emitting Materials Product List; California Collaborative for High Performance Schools (CHPS); current edition at www.chps.net/.
- B. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions From Indoor Sources Using Environmental Chambers; California Department of Public Health; v1.1, 2010.
- C. CRI (GLP) - Green Label Plus Testing Program - Certified Products; www.carpet-rug.org; current edition.
- D. SCS (CPD) - SCS Certified Products; current listings at www.scscertified.com.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Evidence of Compliance: Submit for each different product in each applicable category.
- C. Product Data: For each VOC-restricted product used in the project, submit evidence of compliance.
- D. Installer Certifications Regarding Prohibited Content: Require each installer of any type of product (not just the products for which VOC restrictions are specified) to certify that either 1) no adhesives, joint sealants, paints, coatings, or composite wood or agrifiber products have been used in the installation of installer's products, or 2) that such products used comply with these requirements.

PART 2 PRODUCTS

2.01 MATERIALS

- A. All Products: Comply with the most stringent of federal, State, and local requirements, or these specifications.
- B. All VOC-Restricted Products: Provide products having VOC content of types and volume not greater than those specified in State of California Department of Health Services Standard Practice for the Testing of Volatile Organic Emissions From Various Sources Using Small-Scale Environmental Chambers.
 - 1. Evidence of Compliance: Acceptable types of evidence are:
 - a. Current GREENGUARD Children & Schools certification; www.greenguard.org.
 - b. Current Carpet and Rug Institute Green Label Plus certification; www.carpet-rug.org.
 - c. Current SCS Floorscore certification; www.scs-certified.com.
 - d. Current SCS Indoor Advantage Gold certification; www.scs-certified.com.
 - e. Product listing in the CHPS Low-Emitting Materials Product List at www.chps.net/manual/lem_table.htm.
 - 2. Product data submittals showing VOC content are NOT acceptable forms of evidence.
- C. Joint Sealants: Provide products having VOC content as specified in Section 07 9005.
- D. Paints and Coatings: Provide products having VOC content as specified in Section 09 9000.
- E. Carpet, Carpet Cushion, and Adhesive: Provide products having VOC content as specified in Section 09 6816.
- F. Carpet Tile and Adhesive: Provide products having VOC content as specified in Section 09 6813.

PART 3 EXECUTION

3.01 FIELD QUALITY CONTROL

- A. Owner reserves the right to reject non-compliant products, whether installed or not, and require their removal and replacement with compliant products at no extra cost to Owner.
- B. Additional costs to restore indoor air quality due to installation of non-compliant products will be borne by Contractor.

END OF SECTION

SECTION 01 7000
EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Examination, preparation, and general installation procedures.
- B. Requirements for alterations work, including selective demolition.
- C. Cutting and patching.
- D. Surveying for laying out the work.
- E. Cleaning and protection.
- F. Demonstration and instruction of Owner personnel.
- G. Closeout procedures, including Contractor's Correction Punch List, except payment procedures.
- H. General requirements for maintenance service.
- I. Construction Fire Safety program per NFPA 241

1.02 RELATED REQUIREMENTS

- A. Section 01 1000 - Summary: Limitations on working in existing building; continued occupancy; work sequence; identification of salvaged and relocated materials.
- B. Section 01 3000 - Administrative Requirements: Submittals procedures, Electronic document submittal service.
- C. Section 01 4000 - Quality Requirements: Testing and inspection procedures.
- D. Section 01 5000 - Temporary Facilities and Controls: Temporary exterior enclosures.
- E. Section 01 7800 - Closeout Submittals: Project record documents, operation and maintenance data, warranties, and bonds.
- F. Section 02 4100 - Demolition: Demolition of whole structures and parts thereof; site utility demolition.
- G. Section 07 8400 - Firestopping.

1.03 REFERENCE STANDARDS

- A. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2013.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Submit a Construction Fire Safety Plan per NFPA 241 Requirements.
 - 1. Consult with local AHJ for specific requirements.
- C. Survey work: Submit name, address, and telephone number of Surveyor before starting survey work.
 - 1. On request, submit documentation verifying accuracy of survey work.
 - 2. Submit a copy of site drawing signed by the Land Surveyor, that the elevations and locations of the work are in compliance with Contract Documents.
 - 3. Submit surveys and survey logs for the project record.
- D. Cutting and Patching: Submit written request in advance of cutting or alteration that affects:
 - 1. Structural integrity of any element of Project.
 - 2. Integrity of weather exposed or moisture resistant element.
 - 3. Efficiency, maintenance, or safety of any operational element.
 - 4. Visual qualities of sight exposed elements.

5. Work of Owner or separate Contractor.

1.05 QUALIFICATIONS

- A. For demolition work, employ a firm specializing in the type of work required.
- B. For surveying work, employ a land surveyor registered in the State in which the Project is located and acceptable to Architect. Submit evidence of surveyor's Errors and Omissions insurance coverage in the form of an Insurance Certificate. Employ only individual(s) trained and experienced in collecting and recording accurate data relevant to ongoing construction activities,

1.06 PROJECT CONDITIONS

- A. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.
- B. Dust Control: Execute work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into atmosphere and over adjacent property.
- C. Erosion and Sediment Control: Plan and execute work by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.
- D. Noise Control: Provide methods, means, and facilities to minimize noise produced by construction operations.
 - 1. Outdoors: Limit conduct of especially noisy exterior work to the hours of 8 am to 5 pm.
- E. Pest and Rodent Control: Project site to be batited by extermination company prior to start of construction activities. Maintain baits throughout the duration of the project as required. Provide methods, means, and facilities to prevent pests and insects from damaging the work.
- F. Pollution Control: Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations. Comply with federal, state, and local regulations.

1.07 COORDINATION

- A. Coordinate scheduling, submittals, and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.
- B. Insure that all subcontractors are aware of energy efficiency and air sealing requirements and coordinate work to ensure projected Energy Star rating is acheived, as specified in the performance path requirements of the Massachusetts Energy Star Homes Technical Standards Version 3.0
- C. Notify affected utility companies and comply with their requirements.
- D. Verify that utility requirements and characteristics of new operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.
- E. Coordinate space requirements, supports, and installation of mechanical and electrical work that are indicated diagrammatically on drawings. Follow routing indicated for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- F. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.
- G. Coordinate completion and clean-up of work of separate sections.
- H. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

PART 2 PRODUCTS

2.01 PATCHING MATERIALS

- A. New Materials: As specified in product sections; match existing products and work for patching and extending work.
- B. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing work as a standard.
- C. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Start of work means acceptance of existing conditions.
- B. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.
- C. Examine and verify specific conditions described in individual specification sections.
- D. Take field measurements before confirming product orders or beginning fabrication, to minimize waste due to over-ordering or misfabrication.
- E. Verify that utility services are available, of the correct characteristics, and in the correct locations.
- F. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions.

3.02 PREPARATION

- A. Clean substrate surfaces prior to applying next material or substance.
- B. Seal cracks or openings of substrate prior to applying next material or substance.
- C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

3.03 LAYING OUT THE WORK

- A. Verify locations of survey control points prior to starting work.
- B. Promptly notify Architect of any discrepancies discovered.
- C. Contractor shall locate and protect survey control and reference points.
- D. Control datum for survey is that indicated on drawings.
- E. Protect survey control points prior to starting site work; preserve permanent reference points during construction.
- F. Promptly report to Architect the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.
- G. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect.
- H. Utilize recognized engineering survey practices.
- I. Establish elevations, lines and levels. Locate and lay out by instrumentation and similar appropriate means:
 - 1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations.

2. Grid or axis for structures.
 3. Building foundation, column locations, ground floor elevations.
- J. Periodically verify layouts by same means.
- K. Maintain a complete and accurate log of control and survey work as it progresses.

3.04 GENERAL INSTALLATION REQUIREMENTS

- A. In addition to compliance with regulatory requirements, conduct construction operations in compliance with NFPA 241, including applicable recommendations in Appendix A.
- B. Install products as specified in individual sections, in accordance with manufacturer's instructions and recommendations, and so as to avoid waste due to necessity for replacement.
- C. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.
- D. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.
- E. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.
- F. Make neat transitions between different surfaces, maintaining texture and appearance.

3.05 PROGRESS CLEANING

- A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition daily.
- B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.
- C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.
- D. Collect and remove waste materials, debris, and trash/rubbish from site periodically and dispose off-site; do not burn or bury.

3.06 PROTECTION OF INSTALLED WORK

- A. Protect installed work from damage by construction operations.
- B. Provide special protection where specified in individual specification sections.
- C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.
- D. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- E. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
- F. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- G. Remove protective coverings when no longer needed; reuse or recycle coverings if possible.

3.07 DEMONSTRATION AND INSTRUCTION

- A. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at scheduled time, at equipment location.
- B. Provide a qualified person who is knowledgeable about the Project to perform demonstration and instruction of Owner's personnel.

3.08 ADJUSTING

- A. Adjust operating products and equipment to ensure smooth and unhindered operation.

3.09 FINAL CLEANING

- A. Coordinate final cleaning with required lead testing and punchlist.
- B. Use cleaning materials that are nonhazardous.

- C. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.
- D. Remove all labels that are not permanent. Do not paint or otherwise cover fire test labels or nameplates on mechanical and electrical equipment.
- E. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.
- F. Clean filters of operating equipment.
- G. Clean debris from roofs, gutters, downspouts, scuppers, overflow drains, area drains, and drainage systems.
- H. Clean site; sweep paved areas, rake clean landscaped surfaces.
- I. Clean all interiors of cabinets including drawers and shelves. Remove all construction related debris.
- J. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.

3.10 CLOSEOUT PROCEDURES

- A. Make submittals that are required by governing or other authorities.
 - 1. Provide copies to Architect.
 - 2. Provide copies to Owner.
- B. Accompany Project Coordinator on preliminary inspection to determine items to be listed for completion or correction in the Contractor's Correction Punch List for Contractor's Notice of Substantial Completion.
- C. Notify Architect when work is considered ready for Architect's Substantial Completion inspection.
- D. Submit written certification containing Contractor's Correction Punch List, that Contract Documents have been reviewed, work has been inspected, and that work is complete in accordance with Contract Documents and ready for Architect's Substantial Completion inspection.
- E. Conduct Substantial Completion inspection and create Final Correction Punch List containing Architect's and Contractor's comprehensive list of items identified to be completed or corrected and submit to Architect.
- F. Correct items of work listed in Final Correction Punch List and comply with requirements for access to Owner-occupied areas.
- G. Notify Architect when work is considered finally complete and ready for Architect's Substantial Completion final inspection.
- H. Complete items of work determined by Architect listed in executed Certificate of Substantial Completion.

END OF SECTION

SECTION 01 7419

CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 GENERAL

1.01 WASTE MANAGEMENT REQUIREMENTS

- A. Owner requires that this project generate the least amount of trash and waste possible.
 - 1. Demolition Recycling: Demolition procedures recycle at least 25% of all removed materials by volume including site materials.
 - 2. Construction Waste: At least 75% of construction waste be recycled. Recycle all cardboard and foam packaging materials
- B. Employ processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors.
- C. Minimize trash/waste disposal in landfills; reuse, salvage, or recycle as much waste as economically feasible.
- D. Required Recycling, Salvage, and Reuse: The following may not be disposed of in landfills or by incineration:
 - 1. Aluminum and plastic beverage containers.
 - 2. Corrugated cardboard.
 - 3. Wood pallets.
 - 4. Clean dimensional wood.
 - 5. Metals, including packaging banding, metal studs, sheet metal, structural steel, piping, reinforcing bars, door frames, and other items made of steel, iron, galvanized steel, stainless steel, aluminum, copper, zinc, lead, brass, and bronze.
- E. Contractor shall submit periodic Waste Disposal Reports; all landfill disposal, recycling, salvage, and reuse must be reported regardless of to whom the cost or savings accrues; use the same units of measure on all reports.
- F. Contractor shall develop and follow a Waste Management Plan designed to implement these requirements.
- G. Methods of trash/waste disposal that are not acceptable are:
 - 1. Burning on the project site.
 - 2. Burying on the project site.
 - 3. Dumping or burying on other property, public or private.
 - 4. Other illegal dumping or burying.
- H. Regulatory Requirements: Contractor is responsible for knowing and complying with regulatory requirements, including but not limited to Federal, state and local requirements, pertaining to legal disposal of all construction and demolition waste materials.

1.02 SUBMITTALS

PART 3 EXECUTION

2.01 WASTE MANAGEMENT PLAN IMPLEMENTATION

- A. Manager: Designate an on-site person or persons responsible for instructing workers and overseeing and documenting results of the Waste Management Plan.
- B. Meetings: Discuss trash/waste management goals and issues at project meetings.
- C. Facilities: Provide specific facilities for separation and storage of materials for recycling, salvage, reuse, return, and trash disposal, for use by all contractors and installers.
 - 1. Provide containers as required.
 - 2. Provide adequate space for pick-up and delivery and convenience to subcontractors.
 - 3. Keep recycling and trash/waste bin areas neat and clean and clearly marked in order to avoid contamination of materials.

- D. Hazardous Wastes: Separate, store, and dispose of hazardous wastes according to applicable regulations.
- E. Recycling: Separate, store, protect, and handle at the site identified recyclable waste products in order to prevent contamination of materials and to maximize recyclability of identified materials. Arrange for timely pickups from the site or deliveries to recycling facility in order to prevent contamination of recyclable materials.
- F. Reuse of Materials On-Site: Set aside, sort, and protect separated products in preparation for reuse.
- G. Salvage: Set aside, sort, and protect products to be salvaged for reuse off-site.

END OF SECTION

**SECTION 01 7800
CLOSEOUT SUBMITTALS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Project record documents.
- B. Operation and maintenance data.
- C. Warranties and bonds.

1.02 SUBMITTALS

- A. Project Record Documents: Submit documents to Architect with claim for final Application for Payment.
- B. Operation and Maintenance Data:
 - 1. Submit two copies of preliminary draft or proposed formats and outlines of contents before start of Work. Architect will review draft and return one copy with comments.
 - 2. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit completed documents within ten days after acceptance.
 - 3. Submit one copy of completed documents 15 days prior to final inspection. This copy will be reviewed and returned after final inspection, with Architect comments. Revise content of all document sets as required prior to final submission.
 - 4. Submit two sets of revised final documents in final form within 10 days after final inspection.
- C. Warranties and Bonds:
 - 1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within 10 days after acceptance.
 - 2. Make other submittals within 10 days after Date of Substantial Completion, prior to final Application for Payment.
 - 3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within 10 days after acceptance, listing the date of acceptance as the beginning of the warranty period.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PROJECT RECORD DOCUMENTS

- A. Maintain on site one set of the following record documents; record actual revisions to the Work:
 - 1. Drawings.
 - 2. Addenda.
 - 3. Change Orders and other modifications to the Contract.
- B. Ensure entries are complete and accurate, enabling future reference by Owner.
- C. Store record documents separate from documents used for construction.
- D. Record information concurrent with construction progress.
- E. Record Drawings: Legibly mark each item to record actual construction including:
 - 1. Field changes of dimension and detail.
 - 2. Details not on original Contract drawings.
- F. Permit Documents: Keep a copy of all permits and signoffs for each trade.
 - 1. Submit to Owner all copies of permits at project conclusion.

3.02 OPERATION AND MAINTENANCE DATA

- A. Source Data: For each product or system, list names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.
- B. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.
- C. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.
- D. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

3.03 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES

- A. For Each Product, Applied Material, and Finish:
- B. Instructions for Care and Maintenance: Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental cleaning agents and methods, and recommended schedule for cleaning and maintenance.
- C. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

3.04 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS

- A. For Each Item of Equipment and Each System:
- B. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.
- C. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; typed.
- D. Include manufacturer's printed operation and maintenance instructions.
- E. Additional Requirements: As specified in individual product specification sections.

3.05 ASSEMBLY OF OPERATION AND MAINTENANCE MANUALS

- A. Assemble operation and maintenance data into durable manuals for Owner's personnel use, with data arranged in the same sequence as, and identified by, the specification sections.
- B. Where systems involve more than one specification section, provide separate tabbed divider for each system.
- C. Prepare instructions and data by personnel experienced in maintenance and operation of described products.
- D. Prepare data in the form of an instructional manual.
- E. Binders: Commercial quality, 8-1/2 by 11 inch three D side ring binders with durable plastic covers; 2 inch maximum ring size. When multiple binders are used, correlate data into related consistent groupings.
- F. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.
- G. Project Directory: Title and address of Project; names, addresses, and telephone numbers of Architect, Consultants, Contractor and subcontractors, with names of responsible parties.
- H. Tables of Contents: List every item separated by a divider, using the same identification as on the divider tab; where multiple volumes are required, include all volumes Tables of Contents in each volume, with the current volume clearly identified.

- I. Dividers: Provide tabbed dividers for each separate product and system; identify the contents on the divider tab; immediately following the divider tab include a description of product and major component parts of equipment.
- J. Text: Manufacturer's printed data, or typewritten data on 24 pound paper.
- K. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- L. Contents: Prepare a Table of Contents for each volume, with each product or system description identified, in three parts as follows:
 - 1. Part 1: Directory, listing names, addresses, and telephone numbers of Architect, Contractor, Subcontractors, and major equipment suppliers.
 - 2. Part 2: Operation and maintenance instructions, arranged by system and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify the following:
 - a. Operating instructions.
 - b. Maintenance instructions for equipment and systems.
 - c. Maintenance instructions for special finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.
 - 3. Part 3: Project documents and certificates, including the following:
 - a. Photocopies of warranties and bonds.

3.06 WARRANTIES AND BONDS

- A. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within 10 days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until the Date of Substantial completion is determined.
- B. Verify that documents are in proper form, contain full information, and are notarized.
- C. Co-execute submittals when required.
- D. Retain warranties and bonds until time specified for submittal.

END OF SECTION

SECTION 02 0000
EXISTING CONDITIONS

PART 1 – GENERAL

1.01 GENERAL PROVISIONS

- A. The Conditions of the Contract and other Sections of Division I, General Requirements apply to this section.

1.02 EXISTING CONDITIONS

- A. Before submitting a bid, the Contractor shall make a thorough examination of the conditions at the site, checking the requirements of the Plans and Specifications with the existing conditions.
- B. No claim for extra compensation or extension of time will be allowed on account of the Contractor's failure to estimate properly the quantities, locations, and measurements of all items required to complete the work which could be discerned from visiting the site.
- C. The Contractor shall report any discrepancies to the Engineer and request an interpretation.
- D. Site Plans provided as part of the Contract Documents were created from an on-the-ground survey performed by BSC Group, Inc. in 2017.

PART 2 – PRODUCTS

(NOT USED)

PART 3 – EXECUTION

(NOT USED)

END OF SECTION 02 0000

SECTION 02 2650
STORM WATER POLLUTION PREVENTION PLAN

PART 1—GENERAL

1.01 DESCRIPTION

- A. The storm water pollution prevention measures contained in the SWPPP shall be the minimum required by the EPA and the Town of Wareham. The Contractor shall provide additional measures to prevent pollution from storm water discharges in compliance with the NPDES and all other local, state and federal requirements.
- B. The Contractor shall conduct the storm water management practices in accordance with local regulations and governing authorities, the Federal NPDES permit requirements and for any enforcement action taken or imposed by Federal or State agencies. The cost of any fines, construction delays and remedial actions resulting from the Contractor's failure to comply with all provisions of local regulations and Federal NPDES permit requirements shall be paid for by the Contractor at no additional cost to the Owner.
- C. As a requirement of the EPA's NPDES Phase II permitting program, each Contractor and Subcontractor shall execute a Contractor's Certification form, a copy of which is included at the end of this Section.
- D. The Contractor shall conform to the SWPPP (prepared by BSC Group) and update said Plan as required during the course of the work.

1.02 REFERENCES

- A. Guidance Manual—"Storm Water Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices" (EPA 832-R-005).
- B. Summary of Guidance Manual—"Storm Water Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices" (EPA).
- C. Massachusetts Stormwater Management Policy Handbook (Volume I) and Technical Handbook (Volume II) issued by the Massachusetts Department of Environmental Protection, March 1997.
- D. Massachusetts Sediment and Erosion Control Guideline for Urban and Suburban Areas, March, 1997.

1.03 SUBMITTALS

- A. Signed copy of Contractor's Certification.

1.04 STORM WATER POLLUTION PREVENTION PLAN

- A. The Contractor shall review the SWPPP and provide comments and additions (as outlined below) to the Engineer for incorporation into the SWPPP. The SWPPP will be considered a part of these Contract Documents.
- B. The following general principles shall be followed by the Contractor during the construction phase:
 - Protect and maintain existing vegetation wherever possible.
 - Minimize the area of disturbance.
 - To the extent possible, route unpolluted flows around disturbed areas.
 - Install mitigation devices as early as possible.
 - Minimize the time disturbed areas are left unstabilized.

- Maintain siltation control devices in proper condition.
- C. The Contractor shall include a detailed Oil and Hazardous Materials Management and Spill Control Program section as an integral part of the Storm Water Pollution Prevention Plan. The Oil and Hazardous Materials Management and Spill Control Program (hereinafter referred to as OHM Program) shall address inventory, storage, and on-site handling of oil and hazardous materials as defined by 310 CMR 40.1600, risk mitigation measures, and spill control and reporting procedures that will be implemented by the Contractor during construction at each work site. The OHM Program shall include complete descriptions of all methods, procedures, and Best Management Practices (BMP) proposed to insure compliance with appropriate environmental requirements of the City, the Massachusetts Department of Environmental Protection (DEP), the U.S. Environmental Protection Agency, and all other having jurisdiction. The OHM Program shall be logically organized, and at a minimum shall address the following subjects:
1. Introduction and Objectives. The Contractor shall present an overview of key issues addressed and shall identify the objectives of the OHM Program, e.g. to prevent the release of oil and hazardous materials to the environment through the normal use of appropriately designed engineering controls, properly maintained equipment, operational procedures, inspections, and personnel training, and to minimize the potential environmental impacts resulting from an accidental release of oil and hazardous materials.
 2. Oil and Hazardous Management Practices. The Contractor shall identify practices, procedures, controls, and the like that will be employed in his work to reduce the risks associated with oil and hazardous materials (OHM) storage and usage. Areas that shall be addressed include inventory of OHM, storage of OHM, usage of OHM, and OHM risk mitigation measures. Additional requirements in each of these four areas are presented below:
 - a) **Inventory of Oil and Hazardous Materials.** The Contractor shall identify by means of an inventory list, all oil and hazardous material that will be used or stored at the site, together with approximate quantities and proposed usage application. The inventory list shall be specific in identifying the OHM product names, quantities, and application. The inventory list shall be updated on a monthly basis and maintained in an Appendix to the Storm Water Pollution Prevention Plan.
 - b) **Storage of Oil and Hazardous Materials.** The Contractor shall address on-site storage of oil and hazardous materials and waste at the site. Descriptions of storage arrangements for each item (or class of items, where applicable) contained on the inventory list shall be presented. Descriptions shall identify whether materials will be stored inside a temporary shelter or outside in tanks or containers, design of temporary shelter (e.g. floor material, shelf storage, venting provisions, etc.), conditions of outside storage (e.g. pervious or impervious surface, protection from elements, etc.), design of outside containers (e.g. above-ground or on-ground, size, material of construction, etc.), secondary containment provisions, location and description of proposed structural and nonstructural control measures, etc. Storage of OHM shall conform to applicable industry standards and shall comply with applicable Federal, state and local regulations.
 - c) **On-Site Handling of Oil and Hazardous Materials.** The Contractor shall address on-site usage of oil and hazardous materials at the site. Description of handling arrangements for each item (or class of items, where applicable) contained on the inventory list shall be presented.

- d) **OHM Risk Mitigation Measures.** Due to the limited amount of OHM material to be stored on site, the risks associated with the OHM storage and usage under this Contract is reduced. However, the Contractor shall identify these various risks associated with OHM usage at the site and detail mitigation measures employed to minimize these risks. Mitigation measures that the Contractor intends to implement shall be described.
3. Waste Disposal Practices. The Contractor shall identify practices, procedures, controls, and the like that will be employed in his work to ensure proper collection, storage, removal, and disposal of all construction waste, hazardous waste, used oil, and other waste petroleum products at the site. The Contractor shall additionally identify the following for all hazardous waste that he anticipates will be associated with his operations: the nature of the waste generated at the site and its hazards; the designated “generator”; the method of disposal (use of licensed transporter, manifest and final treatment or receiving facility); management at the job site; and method of transportation off site. All hazardous waste materials shall be disposed of in accordance with applicable state laws M.G.L. c. 21C and implementing regulations 310 CMR 30.000. All records, manifests, and the like associated with storage and off-site transport and disposal of Contractor-generated wastes (exclusive of those associated with transport and disposal of excavated materials in accordance with Section 02240) shall be maintained in an Appendix to the Storm Water Pollution Prevention Plan.
4. Spill Control Procedures. The Contractor shall develop contingency procedures for use in the event of a release of OHM at each work site to minimize adverse impacts to the environment; procedures shall at a minimum comply with applicable provisions of CERCLA, SARA, and the Massachusetts Contingency Plan. Contingency procedures shall identify regulated materials, reportable quantities, and notification requirements in accordance with 310 CMR 40.0000, Massachusetts Contingency Plan, specifically 310 CMR 40.0300 and 310 CMR 40.0345. Notification requirements shall be clearly defined.
- D. The Contractor shall include a detailed Inventory of Materials On Site section as an integral part of the Storm Water Pollution Prevention Plan. The Inventory of Materials On Site shall identify materials that are expected to be stored on site during construction activities.
- E. The Contractor shall provide certifications included as part of the attached Storm Water Pollution Prevention Plan along with any other certifications required to comply with federal, state, and local regulations for storm water management, erosion and sediment control, and oil and hazardous materials management.
- F. The Contractor shall include Appendices as an integral part of the Storm Water Pollution Prevention Plan shall be logically organized, and at a minimum shall facilitate and be utilized for the compilation of the following information and records: plans and figures; completed inspection and maintenance reports; records of grading and stabilization; inventory of oil and hazardous materials; waste disposal records; spill and incidents; other relevant records and documents, including permits, notices, regulations, etc.
- G. Penalties:
Failure to comply with provisions of the NPDES permitting program and the Storm Water Pollution Prevention Plan may result in penalties assessed by the U.S. Environmental Protection Agency, the costs of which would be borne by the Contractor.
- 1.05 IMPLEMENTATION OF THE STORM WATER POLLUTON PREVENTION PLAN
- A. The Storm Water Pollution Prevention Plan, updated in accordance with Paragraphs 1.04 and 1.05 of this Section, shall be implemented and adhered to during all

phases of construction. The Contractor shall retain an up-to-date copy of his Storm Water Pollution Prevention Plan and all Appendices at an on-site construction project office. Such Plan, including all Appendices, shall be available for inspection during normal working hours by the Engineer, the Owner, and all duly-authorized Federal, State, and local officials from the date of initial Plan submittal until the final copy is submitted upon completion of the Work.

- B. The Contractor shall develop appropriate plans, figures, related sketches, etc. as necessary to illustrate the Storm Water Pollution Prevention Plan. Such items shall be maintained in an Appendix to the Storm Water Pollution Prevention Plan as they are developed by the Contractor. At a minimum such drawings shall address the following three elements for the site – (1) Existing Site Conditions; (2) Site Plans (illustrating slopes after grading, areas of disturbance, drainage pattern, etc.); and (3) Site Controls (illustrating erosion and sediment measures, project construction BMP's, OHM management, etc.) – with each element separately addressed on its own drawings or series of drawings.
- C. The following inspection and maintenance practices shall be used to maintain erosion and sediment controls:
 - 1. All control measures identified in the Storm Water Pollution Prevention Plan shall be inspected by a Contractor-designated individual at least once bi-weekly and following any storm event of 0.5 inches or greater.
 - 2. All measures shall be maintained in good working order; if a repair is necessary, it shall be initiated within 48 hours of deficiency identification.
 - 3. The individual who performed the inspection shall complete an Inspection and Maintenance Report for each inspection. Completed Inspection and Maintenance Reports shall be maintained in an Appendix to the SWPPP. The Contractor-developed report form to be completed by the Contractor's inspector shall be submitted to the Engineer for approval, and shall address the control measures identified in the Storm Water Pollution Prevention Plan. A sample Inspection and Maintenance Report form is presented as an Attachment to this Section. Contractor shall further develop this form as necessary to list the specific control measures to be inspected and to provide additional detail based on his proposed work. Inspection activities performed by the Contractor shall in no way limit the Authority or Engineer from conducting their own inspections and identifying deficiencies to the Contractor for correction.
- D. The Contractor shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) to achieve compliance with the conditions of the NPDES General Permit and with the requirements of the Storm Water Pollution Prevention Plan.
- E. The Contractor shall maintain records of dates when major grading activities occur, dates of temporary or permanent cessation of construction, and dates initiation of stabilization measures in an Appendix to the Storm Water Pollution Prevention Plan.
- F. Oil and Hazardous Materials Management and Spill Control
 - 1. For practices not more specifically addressed by federal, state, and local laws and implementing regulations or these Specifications, all oil and hazardous materials and all spills shall be managed in accordance with the Oil and Hazardous Materials Management and Spill Control Program presented in the Storm Water Pollution Prevention Plan.

2. Spills

- a. The NPDES General Permit does not relieve the Contractor of the reporting requirements of the Massachusetts Contingency Plan, 40 CFR Part 117, or 40 CFR Part 302. Where a release containing a hazardous substance in an amount equal to or in excess of a reporting quantity established under the Massachusetts Contingency Plan, 40 CFR Part 117, or 40 CFR Part 302, the Contractor is required to comply with the requirements of the aforementioned regulations and to modify the Storm Water Pollution Prevention Plan if necessary within 15 calendar days of knowledge of the release. Spills of oil or hazardous material shall be reported to the Massachusetts Department of Environmental Protection and/or the National Response Center as appropriate, if the reportable quantity is exceeded. All spills of OHM, in any quantity shall be reported to the Owner.
 - b. The Contractor following each occurrence shall prepare a spill report. Spill report shall present a description of the release, including quantity and type of material, date of spill, circumstances leading to the release, location of spill, response actions and personnel, documentation of notifications, and corrective measures implemented to prevent reoccurrence. Such reports shall be maintained in an Appendix to the Storm Water Pollution Prevention Plan.
 - c. The Contractor shall identify an appropriately trained site employee(s) involved with day-to-day site operations to be the spill prevention and cleanup coordinator. The names(s) of responsible spill personnel shall be posted in the material storage area and in the office trailer on site. Each employee shall be instructed that all spills are to be reported to the spill prevention and cleanup coordinator.
- G. The Contractor shall be required to amend the Plan, whenever there is a change in design, construction, operation, or maintenance, which has a significant effect on the potential for the discharge of pollutants to waters, including the addition of or change in location of storm water discharge points, or if the Plan proves to be ineffective in eliminating or significantly minimizing pollutants in storm water discharges or in otherwise achieving the general objectives of the Plan. Also, where warranted based on the results of an inspection by the Contractor or others, the site description, procedures, or elements of the Plan shall be revised as appropriate; modifications called for by the inspection and resultant changes to the Plan shall be implemented within 7 calendar days following the inspection. In addition, the Plan shall be amended to identify any new subcontractor that will implement a measure of the Plan. Finally, the Plan shall be amended to incorporate specific revisions if so directed by the Engineer, the Owner, or any duly authorized Federal, State, or local official at any time during the performance of the Work under this Contract.

PART 2—PRODUCTS

(NOT USED)

PART 3—EXECUTION

(NOT USED)

END OF SECTION 02 2650

**SECTION 02 4100
DEMOLITION**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Building demolition excluding removal of hazardous materials and toxic substances.
- B. Selective demolition of built site elements.
- C. Abandonment and removal of existing utilities and utility structures.

1.02 RELATED REQUIREMENTS

- A. Section 01 1000 - Summary: Limitations on Contractor's use of site and premises.
- B. Section 01 5000 - Temporary Facilities and Controls: Site fences, security, protective barriers, and waste removal.
- C. Section 01 7000 - Execution and Closeout Requirements: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products; temporary bracing and shoring.
- D. Section 01 7419 - Construction Waste Management and Disposal: Limitations on disposal of removed materials; requirements for recycling.

1.03 REFERENCE STANDARDS

- A. 29 CFR 1926 - U.S. Occupational Safety and Health Standards; current edition.
- B. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2013.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Site Plan: Showing:
 - 1. Vegetation to be protected.
 - 2. Areas for temporary construction and field offices.
- C. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.

PART 2 PRODUCTS

PART 3 EXECUTION

3.01 SCOPE

- A. Remove the entire building designated on the site plan.
- B. Remove paving and curbs as required to accomplish new work.
- C. Remove foundtaions, slabs, etc in their entirety.
- D. Remove concrete slabs on grade within site boundaries.
- E. Remove fences and gates.
- F. Remove items indicated on the drawings and dispose in a legal manner..
- G. Fill excavations, open pits, and holes in ground areas generated as result of removals, using specified fill; compact fill as specified in Section 31 2200.

3.02 GENERAL PROCEDURES AND PROJECT CONDITIONS

- A. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.

1. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
 2. Provide, erect, and maintain temporary barriers and security devices.
 3. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
 4. Do not close or obstruct roadways or sidewalks without permit.
 5. Conduct operations to minimize obstruction of public and private entrances and exits; do not obstruct required exits at any time; protect persons using entrances and exits from removal operations.
 6. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon or limit access to their property.
- B. Do not begin removal until receipt of notification to proceed from Owner.
- C. Protect existing structures and other elements that are not to be removed.
1. Provide bracing and shoring.
 2. Prevent movement or settlement of adjacent structures.
 3. Stop work immediately if adjacent structures appear to be in danger.
- D. Minimize production of dust due to demolition operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.
- E. If hazardous materials are discovered during removal operations, stop work and notify Architect and Owner; hazardous materials include regulated asbestos containing materials, lead, PCB's, and mercury.
- F. Partial Removal of Paving and Curbs: Neatly saw cut at right angle to surface.

3.03 EXISTING UTILITIES

- A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.
- B. Protect existing utilities to remain from damage.
- C. Do not disrupt public utilities without permit from authority having jurisdiction.
- D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.
- E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Owner.
- F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.
- G. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.

3.04 SELECTIVE DEMOLITION FOR ALTERATIONS

- A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
1. Verify that construction and utility arrangements are as indicated.
 2. Report discrepancies to Architect before disturbing existing installation.
 3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.
- B. Remove existing work as indicated and as required to accomplish new work.
- C. **Remove items labeled for salvage and re-use with care. Store properly prior to use.**
1. Remove items indicated on drawings.

- D. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove existing systems and equipment as indicated.
 - 1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components.
 - 2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
 - 3. Verify that abandoned services serve only abandoned facilities before removal.
 - 4. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification.
- E. Protect existing work to remain.
 - 1. Perform cutting to accomplish removals neatly and as specified for cutting new work.
 - 2. Repair adjacent construction and finishes damaged during removal work.
 - 3. Patch as specified for patching new work.

3.05 DEBRIS AND WASTE REMOVAL

- A. Remove debris, junk, and trash from site.
- B. Leave site in clean condition, ready for subsequent work.
- C. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION

SECTION 02 4114
SITE PREPARATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions, are hereby made a part of this Section.

1.02 SUMMARY

- A. Provide all labor, equipment, materials and perform all operations necessary to complete the work of this Section as indicated within the Drawings and specified herein which shall include but is not limited to the following:

1. Protection of existing site conditions to remain.
2. Protection of existing trees to remain.
3. Selective clearing and thinning.
4. Clearing and grubbing of vegetation, refuse, trash, and debris within the indicated limits.
5. Topsoil stripping, stockpiling and/or removal off-site, storage and return to the site.
6. Filling of voids and excavations resulting from the work.
7. Removal of pavement.
8. Removal or relocation of existing site features.
9. Demolition of miscellaneous structures, signage, fencing, light standards, and other appurtenances that interfere with construction.
10. Erosion control.
11. Construction fence.

- B. Related Work: The following Sections contain work related to this Section:

1. Section 31 01 30 – Earthwork
2. Section 31 25 10 – Erosion and Sedimentation Control
3. Section 31 25 11 – Temporary Dust Control

1.03 SUBMITTALS

- A. Prior to ordering the below listed materials, submit product literature to Engineer for approval as follows. Do not order materials until Engineer's approval has been obtained.

1. Erosion control materials.
2. Catch basin inlet protection.

1.04 CODES AND STANDARDS

- A. Perform demolition and clearing work in accordance with applicable rules, regulations, codes and ordinances of Local, State and Federal Authorities, and in accordance the public utility corporations having jurisdiction over the work.

1.05 FEES AND PERMITS

- A. The Contractor (and the appropriate licensed subcontractor when applicable) shall secure and the Owner shall pay for any and all permits. Refer to General Conditions of the Contract for Construction for additional details.

1.06 PROJECT CONDITIONS

A. Examination of Conditions

1. The Contractor shall be solely responsible for judging the full extent of work requirements involved, including but not limited to the potential need for storing materials temporarily and/or rehandling items prior to final installation.
2. Traffic: Conduct site-clearing operations to ensure minimum interference with roads and other used facilities. Do not close or obstruct roads or used facilities without permission from authorities having jurisdiction.

1.07 EXISTING SERVICES

A. All locations of existing utilities shown on the plan have been developed from existing utility records and/or above ground inspection of the site. Completeness or accuracy of locations or depth of underground utility or structures cannot be guaranteed. Contractor must verify the location and depth of all underground utilities or structures prior to the start of work.

1. Call Dig-Safe at 1-888-344-7233 seventy-two (72) hours prior to excavation and construction. Record locations on Project Record Documents from Dig-Safe field location markings.

B. Notify affected utility companies in advance and obtain written approval prior to commencing this Work.

1. Coordinate and pay all applicable fees for disconnecting, removing, capping, and plugging utility services.

C. The Contractor shall be responsible for the location, sealing, disconnection and/or protection of all existing utilities such as water, sewers, drains, electricity and telephone in accordance with the regulations of the utility concerned.

D. Place markers to indicate location of disconnected services. Identify service lines and capping locations on Project Record Documents.

1.08 MATERIALS OWNERSHIP

A. Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain on the Owner's property, demolished materials shall become the Contractor's property and shall be removed from the site and disposed of in a legal manner.

B. Historical items, relics, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, antiques, and other items of interest or value to the Owner, which may be encountered during site preparation, remain the Owner's property. Carefully remove and salvage each item or object in a manner to prevent damage and deliver promptly to the Owner.

1.09 STANDARDS

A. Except as modified by governing codes and by the Contract Documents, comply with applicable provisions and recommendations of the following:

1. Standard Specification: Commonwealth of Massachusetts, Department of Public Works, Standard Specifications for Highways and Bridges, latest edition.
2. AASHTO: American Association of State Highway and Transportation Officials, latest edition.
3. ASTM: American Society of Testing and Materials, latest edition.
4. ADA: Americans with Disabilities Act, latest edition.

5. ABB: Architectural Barriers Board, Commonwealth of Massachusetts Regulation 521 CMR.

PART 2 - PRODUCTS

2.01 CONSTRUCTION FENCE

- A. 6' temporary chain link construction fence as needed to prevent unauthorized access to the construction site.

2.02 TREE PROTECTION FENCING

- A. All existing trees to remain shall be protected.

PART 3 - EXECUTION

3.01 GENERAL

- A. Before commencing Site Preparation work, the Contractor shall meet jointly with the Owner and the Engineer in order to discuss the procedures to be utilized. Contractor shall be held responsible for any damage to all vegetation designated to remain. The Engineer will be sole judge as to damage inflicted.
 1. The Engineer shall make the final determination of action required regarding any and all items indicated for removals, stockpiling, disposal, adjustment and protection.
- B. The Contractor shall give the Owner adequate advance notice of his readiness to start Site Preparation work in order that the Owner can review the Contractor's plans for parking and access to the construction site.
- C. The work shall be conducted with prime consideration given to the following:
 1. Compliance with governing laws and building codes.
 2. Safety, protection, and convenience of the public and workmen.
 3. Minimization of dirt and dust proliferation.
 4. Neat and accurate cutting and trimming of elements to be partially removed, subject to the Engineer's approval.
 5. Avoidance of any damage to existing vegetation to remain.

3.02 UTILITIES

- A. Notify all corporations, companies, individuals or local authorities owning, or having jurisdiction over, utilities running to, through or across areas to be affected by demolition operations.
- B. Locate and identify existing utilities that are to remain and protect them from damage.
- C. Have all discontinued utility services disconnected in accordance with the requirements of the utility owner.

3.03 EROSION CONTROL

- A. Install erosion control as required prior to commencement of site preparation operations, in accordance with Section 31 25 10 – Erosion and Sedimentation Control.

3.04 PROTECTION OF EXISTING CONDITIONS

- A. Protection of Existing Improvements: Provide protections necessary to prevent damage to existing improvements indicated to remain in place. In the event of damage, immediately make all repairs and replacements necessary to the approval of the Engineer at no additional cost to the Owner.
 1. Protect improvements on adjoining properties and on Owner's property.

- B. Before clearing begins, protect designated trees with tree protection fencing to the approximate diameter of foliage (dripline) to prevent damage to the trunk, foliage and root system by construction equipment and procedures. Do not stockpile materials within the drip line of existing trees to remain.
- C. Place tree protection fencing as required protecting other plants, monuments, existing improvements and adjacent property areas that are designated to remain from damage.
- D. The Contractor shall repair or replace immediately any damage to existing trees or root systems that are to remain. The Contractor shall employ an arborist licensed in the Commonwealth of Massachusetts to determine the repair and replacement needs and methods for approval by the Engineer.
- E. Replace damaged shrubs and other vegetation designated to remain with the same size and species.
- F. Tree-protection fencing shall be maintained for the duration of construction operations. The work shall include immediate replacement of any damaged fence.
- G. Maintain protected vegetation in a healthy growing condition during construction.
- H. The Contractor shall be liable for all damage and/or disturbance to existing trees and shrubs not otherwise designated for clearing and removal. When the Contractor's operations damage trees and/or other vegetation to remain, comparable replacement shall be performed as approved by the Engineer at full replacement cost to the Contractor

3.05 DEMOLITION REQUIREMENTS

- A. Conduct demolition operations in accordance with the accepted site plan and in a manner that will prevent damage to adjacent structures, utilities, pavements and other facilities to remain.
- B. Cease operations immediately if any damage, settlement or other adverse effect on adjacent structures occurs. Immediately notify the Engineer and regulatory authorities. Do not resume operations until conditions are corrected, damage repaired and approval has been received from the Engineer.
- C. Provide hoses and water connections. Spray water on demolition debris to minimize dust. Refer to Section 31 25 11 – Temporary Dust Control.
- D. Clean adjacent structures and improvements of dust, dirt, and debris caused by demolition operations. Return adjacent areas to condition existing prior to start of work.
- E. Locate demolition equipment and remove materials in a manner that prevents excessive loading to supporting walls, floors, or framing.
- F. All hazardous waste removal shall be performed by a hazardous waste Contractor qualified and duly licensed by the Commonwealth of Massachusetts to remove, transport and dispose of each type of hazardous substance.

3.06 SITE CLEARING

- A. General: Remove trees, shrubs, grass, and other vegetation, improvements, or obstructions, as indicated within the drawings and as required to permit installation of new construction. Remove similar items elsewhere on site or premises as specifically indicated. Removal includes digging out and off-site disposal of stumps and roots.

3.07 CLEARING AND GRUBBING

- A. The Contractor shall accept the site as he finds it and shall remove and legally dispose off-site all plants designated for removal and all debris, organic matter, and objectionable material which is not suitable at no additional cost to the Owner.

- B. Trees, shrubs, and vines and all stumps to be removed under clearing and grubbing shall be as indicated on the drawings and as directed by the Engineer. No burning shall be allowed on site. Dispose of all material legally off site at no additional cost to the Owner.
 - 1. Before any tree, shrub, vine, or stump removal is initiated, the Contractor shall arrange a conference on the site with the Landscape Architect to review procedures for protection of existing vegetation to remain, removal of existing vegetation and clearing and grubbing operations.
- C. Clearing and Grubbing: Clear site of trees, shrubs, and other vegetation, except for those indicated to remain.
 - 1. Completely remove all stumps and roots to a depth not less than eighteen inches (18") below original ground level for shrubs and three feet (3') below original ground level for trees.
 - 2. Use only hand methods for grubbing inside drip line of trees indicated to remain.
 - 3. Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.
 - 4. Unless further excavation is required, fill depressions caused by clearing and grubbing operations with Ordinary Borrow material.
 - a. Place borrow material in horizontal layers not exceeding six (6) inches loose depth, and thoroughly compact each layer to a density equal to adjacent original ground.

3.08 REMOVAL AND ABANDONMENT OF UTILITIES

- A. All existing utility structures, conduits, and appurtenances of any kind shall be completely removed within and around the limits of excavation for new buildings, stormwater detention and infiltration areas, and subsurface sanitary sewer disposal areas unless noted otherwise on the Drawings.
- B. Manholes and catch basins to be abandoned shall have all lines plugged with brick and mortar prior to filling with sand or gravel. The top 4 feet of these structures shall be removed and the bottom slab broken up prior to filling.

3.09 TOPSOIL STRIPPING AND STOCKPILING

- A. Topsoil: Topsoil is defined as friable clay loam surface soil found in a depth of not less than four (4) inches. Satisfactory topsoil is reasonably free of subsoil, clay lumps, stones, and other objects over one (1) inch in diameter, and without weeds, roots, and other objectionable material.
 - 1. Strip topsoil to whatever depths encountered in a manner to prevent intermingling with underlying subsoil or other objectionable material. Topsoil that is contaminated with subsoil shall not be used as loam borrow. Remove heavy growths of grass from areas before stripping.
 - a. Topsoil excavation and stockpiling shall consist of discing and harrowing grassed areas at ninety (90) degrees to each prior operation, and removing topsoil from all areas of proposed work, screening it and storing in approved topsoil stockpiles to ensure organic matter decomposition.
 - b. Where existing trees are indicated to remain, leave existing topsoil in place within drip lines to prevent damage to root system.
 - 2. Stockpile topsoil in storage piles in on-site areas as directed by the Engineer and Owner. Construct storage piles to provide free drainage of surface water. Cover

storage piles to prevent erosion; install silt fence and hay bales around entire perimeter.

3. Topsoil is to remain and be reused on site. Unsuitable topsoil is to be classified as Urban Fill as specified in Section 31 01 30 – Earthwork.
4. When required for site work, all existing topsoil to be reused shall be screened.

3.10 REMOVAL OF EXISTING PAVEMENT

- A. All items to be removed, stockpiled or designated for reuse shall include, but are not limited to, those items as indicated on the Contract Drawings.
- B. Remove existing bituminous concrete pavement, concrete pavement, concrete slabs and all other pavements as indicated on the Drawings. All material shall be removed from the site and returned to a recycling plant for reuse. Said pavements and concrete materials shall not be transported to landfills, incinerators or other disposal areas.

Note: The Contractor shall provide the Architect/Engineer and Owner with the name and location of the facility for approval before any removal of material is to occur.
- D. Included in this item will be all saw cutting of pavement, in areas where existing pavement is to remain as indicated within the Drawings. All sawed edges of paving shall be protected from damage until new is placed against it. Existing pavement that is damaged, disturbed or settled, shall be cut back by the same method and replaced as directed by the Engineer at no additional cost to the Owner.
- E. If, after the existing pavement and base materials are removed to the depth required, and the Engineer deems the underlying gravel satisfactory for pavement subbase, he shall direct the Contractor to leave the existing gravel in place and/or supplement it with additional material as required to bring the subbase to the proper grade. Existing material shall be compacted as specified under Section 31 01 30 – Earthwork.

3.11 REMOVALS/ REMOVE AND REINSTALL

- A. All items to be removed, stockpiled or for reuse shall include, but are not limited to those items as indicated on the Contract Drawings.
 1. The Contractor shall be responsible for delivering all items designated for stockpiling and or reuse to a designated area on the site, and as directed by the Owner's representative.
- B. The Contractor shall demolish and remove all items necessary to complete the Work as shown and as indicated within the Drawings. Use methods required to complete work within limitations of governing regulations and as follows:
 1. Dispose of demolished and abandoned items and materials promptly. On-site storage or sale of removed items is prohibited.
 2. The items to be removed may include, but is not limited to, piping, concrete and bituminous sidewalks, light standards and bases, signs, monuments and similar material.

3.12 PATCHING AND REPAIRS

- A. Promptly patch and repair holes and damaged surfaces caused to adjacent construction by selective demolition operations.

3.13 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site.
- B. Burning: Burning on Owner's property is not permitted.

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

3.14 GENERAL CLEAN-UP

- A. Remove from site all trash, litter and debris and leave site in a neat and orderly condition on a daily basis and to the satisfaction and approval of the Owner's Representative.

END OF SECTION 02 4114

SECTION 03 3000
CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Concrete formwork.
- B. Floors and slabs on grade.
- C. Concrete shear walls, elevator shaft walls, and foundation walls.
- D. Concrete reinforcement.
- E. Joint devices associated with concrete work.
- F. Miscellaneous concrete elements, including equipment pads, light pole bases, and Utility trench encasement.
- G. Concrete curing.
- H. Concrete Piers

1.02 RELATED REQUIREMENTS

- A. Section 07 2100 - Thermal Insulation
- B. Section 07 9200 - Joint Sealants: Products and installation for sealants and joint fillers for saw cut joints and isolation joints in slabs.
- C. Section 32 1313 - Concrete Paving: Sidewalks, curbs and gutters.

1.03 REFERENCE STANDARDS

- A. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials; 2010.
- B. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete; 1991 (Reapproved 2009).
- C. ACI 301 - Specifications for Structural Concrete; 2010 (Errata 2012).
- D. ACI 302.1R - Guide for Concrete Floor and Slab Construction; 2004 (Errata 2007).
- E. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete; 2000.
- F. ACI 305R - Hot Weather Concreting; 2010.
- G. ACI 306R - Cold Weather Concreting; 2010.
- H. ACI 308R - Guide to Curing Concrete; 2001 (Reapproved 2008).
- I. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; 2011.
- J. ACI 347R - Guide to Formwork for Concrete; 2014.
- K. ASTM A185/A185M - Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete; 2007.
- L. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement; 2015.
- M. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2013.
- N. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2015a.
- O. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2015.
- P. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2012.
- Q. ASTM C150/C150M - Standard Specification for Portland Cement; 2015.

- R. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete; 2010a.
- S. ASTM C685/C685M - Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing; 2014.
- T. ASTM C1602/C1602M - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete; 2012.
- U. 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; 2011.
- V. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs; 2011.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Submit manufacturers' data on manufactured products showing compliance with specified requirements and installation instructions.
- C. Mix Design: Submit proposed concrete mix design.
 - 1. Indicate proposed mix design complies with requirements of ACI 301, Section 4 - Concrete Mixtures.
 - 2. Indicate proposed mix design complies with requirements of ACI 318, Chapter 5 - Concrete Quality, Mixing and Placing.
- D. Samples: Submit samples of underslab vapor retarder to be used.
- E. Test Reports: Submit report for each test or series of tests specified.

1.05 QUALITY ASSURANCE

- A. Perform work of this section in accordance with ACI 301 and ACI 318.
- B. Follow recommendations of ACI 305R when concreting during hot weather.
- C. Follow recommendations of ACI 306R when concreting during cold weather.

PART 2 PRODUCTS

2.01 FORMWORK

- A. Formwork Design and Construction: Comply with guidelines of ACI 347R to provide formwork that will produce concrete complying with tolerances of ACI 117.
- B. Form Materials: Contractor's choice of standard products with sufficient strength to withstand hydrostatic head without distortion in excess of permitted tolerances.
 - 1. Earth Cuts: Do not use earth cuts as forms for vertical surfaces. Natural rock formations that maintain a stable vertical edge may be used as side forms.
 - 2. Form Coating: Release agent that will not adversely affect concrete or interfere with application of coatings. **Form release coating shall be biodegradable.**

2.02 REINFORCEMENT MATERIALS

- A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi).
 - 1. Type: Deformed billet-steel bars.
 - 2. Finish: Unfinished, unless otherwise indicated.
- B. Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain type.
 - 1. Form: Coiled Rolls.
 - 2. Mesh Size and Wire Gage: As indicated on drawings.
- C. Reinforcement Accessories:
 - 1. Tie Wire: Annealed, minimum 16 gauge, 0.0508 inch.
 - 2. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement.

2.03 CONCRETE MATERIALS

- A. Cement: ASTM C150/C150M, Type I - Normal Portland type.
- B. Fine and Coarse Aggregates: ASTM C33/C33M.
- C. Water: ASTM C1602/C1602M; clean, potable, and not detrimental to concrete.

2.04 ADMIXTURES

- A. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.
- B. Air Entrainment Admixture: ASTM C260/C260M.

2.05 ACCESSORY MATERIALS

- A. Underslab Vapor Retarder:
 - 1. Sheet Material: ASTM E1745, Class A; stated by manufacturer as suitable for installation in contact with soil or granular fill under concrete slabs. Single ply polyethylene is prohibited. 6 mil. Min. Thickness
 - 2. Accessory Products: Vapor retarder manufacturer's recommended tape, adhesive, mastic, prefabricated boots, etc., for sealing seams and penetrations.

2.06 CONCRETE MIX DESIGN

- A. Proportioning Normal Weight Concrete: Comply with ACI 211.1 recommendations.
- B. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended or required by manufacturer.
- C. Normal Weight Concrete:
 - 1. Compressive Strength, when tested in accordance with ASTM C39/C39M at 28 days: 3000 pounds per square inch. for foundation walls, 4000 pounds per square inch for floor slabs.
 - 2. Water-Cement Ratio: Maximum 40 percent by weight.
 - 3. Maximum Slump: 3 inches.
 - 4. Maximum Aggregate Size: 5/8 inch.

2.07 MIXING

- A. On Project Site: Mix in drum type batch mixer, complying with ASTM C685/C685M. Mix each batch not less than 1-1/2 minutes and not more than 5 minutes.
- B. Transit Mixers: Comply with ASTM C94/C94M.
- C. Adding Water: If concrete arrives on-site with slump less than suitable for placement, do not add water that exceeds the maximum water-cement ratio or exceeds the maximum permissible slump.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify lines, levels, and dimensions before proceeding with work of this section.

3.02 PREPARATION

- A. Formwork: Comply with requirements of ACI 301. Design and fabricate forms to support all applied loads until concrete is cured, and for easy removal without damage to concrete.
- B. Verify that forms are clean and free of rust before applying release agent.
- C. Interior Slabs on Grade: Install vapor retarder under interior slabs on grade. Comply with ASTM E1643. Lap joints minimum 6 inches. Seal joints, seams and penetrations watertight with manufacturer's recommended products and follow manufacturer's written instructions. Repair damaged vapor retarder before covering.

3.03 INSTALLING REINFORCEMENT AND OTHER EMBEDDED ITEMS

- A. Comply with requirements of ACI 301. Clean reinforcement of loose rust and mill scale, and accurately position, support, and secure in place to achieve not less than minimum concrete coverage required for protection.
- B. Install welded wire reinforcement in maximum possible lengths, and offset end laps in both directions. Splice laps with tie wire.

3.04 PLACING CONCRETE

- A. Place concrete in accordance with ACI 304R.
- B. Place concrete for floor slabs in accordance with ACI 302.1R.
- C. Finish floors level and flat, unless otherwise indicated, within the tolerances specified below.

3.05 SLAB JOINTING

- A. Locate joints as indicated on drawings.
- B. Anchor joint fillers and devices to prevent movement during concrete placement.
- C. Isolation Joints: Use preformed joint filler with removable top section for joint sealant, total height equal to thickness of slab, set flush with top of slab.
- D. Saw Cut Contraction Joints: Saw cut joints before concrete begins to cool, within 4 to 12 hours after placing; use 3/16 inch thick blade and cut at least 1 inch deep but not less than one quarter (1/4) the depth of the slab.

3.06 FLOOR FLATNESS AND LEVELNESS TOLERANCES

- A. Maximum Variation of Surface Flatness:
 - 1. Exposed Concrete Floors: 1/4 inch in 10 feet.
 - 2. Under Seamless Resilient Flooring: 1/4 inch in 10 feet.
 - 3. Under Carpeting: 1/4 inch in 10 feet.
- B. Correct the slab surface if tolerances are less than specified.
- C. Correct defects by grinding or by removal and replacement of the defective work. Areas requiring corrective work will be identified. Re-measure corrected areas by the same process.

3.07 CONCRETE FINISHING

- A. Concrete Slabs: Finish to requirements of ACI 302.1R, and as follows:
 - 1. Surfaces to Receive Thick Floor Coverings: "Wood float" as described in ACI 302.1R; thick floor coverings include quarry tile, ceramic tile, and Portland cement terrazzo with full bed setting system.
 - 2. Surfaces to Receive Thin Floor Coverings: "Steel trowel" as described in ACI 302.1R; thin floor coverings include carpeting, resilient flooring, seamless flooring, resinous matrix terrazzo, thin set quarry tile, and thin set ceramic tile.
 - 3. Other Surfaces to Be Left Exposed: Trowel as described in ACI 302.1R, minimizing burnish marks and other appearance defects.

3.08 CURING AND PROTECTION

- A. Comply with requirements of ACI 308R. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
- B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
- C. Surfaces Not in Contact with Forms:
 - 1. Initial Curing: Start as soon as free water has disappeared and before surface is dry. Keep continuously moist for not less than three days by water ponding, water-saturated sand, water-fog spray, or saturated burlap.
 - 2. Final Curing: Begin after initial curing but before surface is dry.

3.09 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Section 01 4000 - Quality Requirements.
- B. Provide free access to concrete operations at project site and cooperate with appointed firm.
- C. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of concrete operations.
- D. Tests of concrete and concrete materials may be performed at any time to ensure compliance with specified requirements.
- E. Compressive Strength Tests: ASTM C39/C39M, for each test, mold and cure three concrete test cylinders. Obtain test samples for every 100 cubic yards or less of each class of concrete placed.
- F. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.
- G. Perform one slump test for each set of test cylinders taken, following procedures of ASTM C143/C143M.

3.10 DEFECTIVE CONCRETE

- A. Test Results: The testing agency shall report test results in writing to Architect and Contractor within 24 hours of test.
- B. Defective Concrete: Concrete not complying with required lines, details, dimensions, tolerances or specified requirements.
- C. Repair or replacement of defective concrete will be determined by the Architect. The cost of additional testing shall be borne by Contractor when defective concrete is identified.
- D. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Architect for each individual area.

3.11 PROTECTION

- A. Do not permit traffic over unprotected concrete floor surface until fully cured.

END OF SECTION

SECTION 03 3010
SITE CAST-IN-PLACE CONCRETE

PART 1—GENERAL

1.01 DESCRIPTION

- A. This Section specifies requirements for concrete cast-in-place on the site.
- B. The work includes cast-in-place concrete pavement and bases.

1.02 RELATED SECTIONS

- A. Sections which directly relate to the work of this Section include:
 - 1. Section 31 0130 – Earthwork

1.03 REFERENCE STANDARDS

- A. References herein are made in accordance with the following abbreviations and all work under this Section shall conform to the latest editions as applicable.

American Concrete Institute (ACI)

ACI 301 - Specifications for Structural Concrete for Building

ACI 305R - Hot Weather Concreting

ACI 306R - Cold Weather Concreting

ACI 316R - Recommendations for Construction of Concrete Pavements and Concrete Bases

American Society for Testing and Materials (ASTM)

ASTM 185 - Welded Wire Steel Fabric for Concrete Reinforcement

ASTM 615 - Deformed and Plain Billet Steel Bars for Concrete Reinforcement

ASTM C33 - Concrete Aggregates

ASTM C94 - Ready-Mixed Concrete

ASTM C143 - Slump of Portland Cement Concrete

ASTM C150 - Portland Cement

ASTM C171 - Sheet Materials for Curing Concrete

ASTM C231 - Air Content of Freshly Mixed Concrete by the Pressure Method

ASTM C260 - Air Entraining Admixtures for Concrete

ASTM C309 - Liquid Membrane-Forming Compounds for Curing Concrete

ASTM C494 - Chemical Admixtures for Concrete

Concrete Reinforcing Steel Institute (CRSI)

CRSI - Manual of Standard Practice.

Americans with Disabilities Act and State Regulations

1.04 QUALITY ASSURANCE

- A. Work and materials for construction of the cement concrete walks shall conform to ACI 316R. Other cast-in-place concrete shall conform to ACI 301.
- B. Work, materials, and color of the wheelchair ramp paving shall conform to applicable sections of Americans with Disabilities Act (ADA) and State standards, whichever is more stringent.
- C. Dimensions, locations, and details of equipment pads, anchors, supports, and similar features shown on the drawings are approximate. Manufacturer's approved

shop Drawings of equipment to be supported, anchored, or contained thereby shall be consulted for exact location, size and details.

1.05 SUBMITTALS

- A. Description of methods and sequence of placement for each type of specially-finished concrete, including description of methods and sequence of placement.
- B. Manufacturer's product data for the following:
 - 1. Form release agent.
 - 2. Concrete coloring additive.
 - 3. Preformed joint filler.

1.06 TESTING

- A. The Owner may employ an independent testing laboratory to inspect and test concrete paving and other cast-in-place concrete work.
- B. Testing of materials and installed work may occur at any time during progress of the work. Rejected materials and installed work shall be removed and replaced at no additional cost to the Owner.

PART 2—PRODUCTS

2.01 PORTLAND CEMENT CONCRETE

- A. Portland cement concrete shall:
 - 1. Have a maximum water cement ratio of 0.45 conforming to ACI 316R.
 - 2. Be Air-entrained type conforming to ASTM C94. Air content by volume shall be 6 percent + 1 percent, and shall be tested in accordance with ASTM C260.
 - 3. Placed with a slump not less than 3 inches nor greater than 4 inches, determined in accordance with ASTM C143.
 - 4. Use cement conforming to ASTM C150, Type I or II. Only one color of cement, all of the same manufacturer, shall be used for the work.
 - 5. Use fine and coarse aggregates conforming to ASTM C33.
 - 6. Contain a water reducing agent to minimize cement and water content of the concrete mix at the specified slump. Water reducing agent shall conform to ASTM C494, Type A.
 - 7. Contain no calcium chloride or admixtures containing calcium chloride shall be added to the concrete. No admixtures other than those specified shall be used in the concrete without the specific written permission of the Engineer in each case.

2.04 CURING MATERIALS FOR UNCOLORED CONCRETE

- A. Curing shall be accomplished by the following methods:
 - 1. Moist curing with burlap covering.
 - 2. Curing paper, nonstaining, fiber reinforced laminated Kraft bituminous product conforming to ASTM C171. Four mil polyethylene sheeting may be substituted for curing paper.
 - 3. Curing compound, a resin-base, white pigmented compound conforming to ASTM C309, Type 2.

2.05 EXPANSION JOINTS

- A. Expansion joint filler shall be preformed, nonbituminous type conforming to ASTM D1752, Type II, similar to Sealtight Cork Expansion Joint Filler, manufactured by W.R. Meadows, Inc., Elgin, IL 60120, or approved equivalent.

1. Premolded filler shall be one piece for the full depth and width of the joint.
- B. Smooth dowel shall be hot rolled plain steel dowel bonded at one end and operating in smooth close fitting sleeve (of same material) at the other.

2.06 FORMS

- A. Cylindrical Forms: Sonotube Fibre Forms, wax-impregnated strippable forms manufactured by Sonoco Products Company, General Products Division, ABS or PVC plastic reusable forms, or approved equivalent.
- B. Forms for Exposed Finish: Plywood, metal, metal-framed plywood faced, or other acceptable panel materials. Plywood shall be APA Ref. 1 B-B (Concrete Form), Class I Exterior Grade plywood or B-B or A-C Class I high density overlay concrete form plywood. Form work materials shall produce smooth, continuous, straight and level surfaces.
- C. Forms for Unexposed Finish: Plywood, lumber or metal, with lumber dressed on at least two edges and one side.
- D. Form Ties: Prefabricated, adjustable length galvanized steel snap-off ties, with brackets, cones, cornerlocks and other accessories as necessary.
- E. Form Release Agent: Commercial formulation compounds that will not bond with, stain or adversely affect concrete.

PART 3—EXECUTION

3.01 PREPARATION OF SUBGRADE

- A. The subgrade of areas to be paved shall be graded and compacted as specified in Section 32 11 10, Pavement Subbase Base and Bases.
- B. Excavation required in pavement subgrade shall be completed before fine grading and final compaction of subgrade are performed. Where excavation must be performed in completed subgrade, subbase, base, or pavement, subsequent backfill and compaction shall be performed as required by the Engineer and as specified in Section 31 01 30, Earthwork.
- C. Materials shall not be stored or stockpiled on subgrade.
- D. Prepared subgrade will be inspected by the Engineer. Subgrade shall be approved for installation of the gravel base course. Disturbance to subgrade caused by inspection procedures shall be repaired.

3.02 BASE COURSE

- A. Base course for concrete paving shall be pavement subbase course or gravel base materials specified in Section 32 11 10, Pavement Subbase Base and Bases, as shown on the Drawings.
- B. Width of base course shall extend beyond edge of the proposed pavement as shown on the Drawings.
- C. Material shall be placed in lifts no more than 6 inches thick, compacted measure. Each lift shall be separately compacted to specified density.
 1. Material shall be placed adjacent to wall, manhole, catch basin, and other structures only after they have been set to required grade.
 2. Rolling shall begin at sides and progress to center of crowned areas, and shall begin on low side and progress toward high side of sloped areas. Rolling shall continue until material does not creep or wave ahead of roller wheels.
 3. Surface irregularities which exceed 1/2 inch as measured by means of a 10 foot long straightedge, shall be regraded and recompacted.

- D. Base course shall be compacted at optimum moisture content to not less than 95 percent of maximum density as determined by ASTM D1557.
- E. The base course shall be kept clean and uncontaminated. Less select materials shall not be permitted to become mixed with the base course material.

3.03 FORMS

- A. General: Design, erect, support, brace, and maintain formwork to support vertical, lateral, static, and dynamic loads that might be applied until concrete structure can support such loads. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation, and position. Maintain formwork construction tolerances and surface irregularities complying with the following ACI 347 limits.
 - 1. Provide Class A tolerances for concrete surfaces exposed to view.
 - 2. Provide Class C tolerances for other concrete surfaces.
- B. Construct forms to provide for openings, offsets, sinkages, keyways, recesses, moldings, chamfers, blocking, screeds, bulkheads, anchorages, and inserts, and other features required for the work. Use selected materials to obtain required finishes. Solidly butt joints and provide back-up at joints to prevent cement paste from leaking.
- C. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Kerf wood inserts for forming keyways, reglets, recesses, and other features for easy removal.
- D. Chamfer exposed corners and edges, using wood, metal, PVC, or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.
- E. Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt or other debris just before placing concrete. Re-tighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

3.04 INSTALLING EMBEDDED ITEMS

- A. General: Set and build into formwork the anchorage devices and other embedded items required for work that is attached to, or supported by, cast-in-place concrete. Use setting drawings, diagrams, instructions, and directions provided by suppliers of items to be attached.
- B. Forms for Slabs: Set edge forms, bulkheads, and intermediate screen strips for slabs to achieve required elevations and contours in finished surfaces. Provide and secure units to support screed strips using strike-off templates or compacting-type screeds.

3.05 PREPARING FORM SURFACES

- A. Coat contact surfaces of forms with an approved, nonresidual, low-VOC form-coating compound before placing reinforcement.

3.06 CONCRETE PLACING

- A. Equipment, methods of mixing and placing, and precautions to be observed as to weather, and condition of base shall meet the requirements of ACI 316R.
- B. The Engineer shall be notified of scheduled concrete placement sufficiently in advance of start of operation to allow preliminary inspection of the work, including subgrade, forms, and reinforcing steel.
- C. Work shall not be performed during rainy weather or when temperature is less than 40°F (4.4°C).

- D. Adjacent work shall be protected from stain and damage. Damaged and stained areas shall be replaced or repaired to equal their original conditions.
- E. Existing concrete, earth, and other water-permeable material against which new concrete is to be placed shall be thoroughly damp when concrete is placed. There shall be no free water on surface.
- F. Concrete which has set or partially set, before placing shall not be used. Retempering of concrete will not be permitted.
- G. Concrete shall be thoroughly vibrated, or otherwise consolidated to secure a solid and homogeneous mass, thoroughly worked around reinforcement and into corners of forms.
- H. When joining fresh concrete to concrete which has attained full set, latter shall be cleaned of foreign matter, and mortar laitance shall be removed by chipping and washing. Clean, roughened base surface shall be saturated with water, but shall have no free water on surface. A coat of 1:1 cement-sand grout, approximately 1/8 inch thick, shall be well scrubbed into the thoroughly dampened concrete base. New concrete shall be placed immediately, before grout has dried or set.

3.07 FINISHING

- A. Concrete surfaces shall be screened and finished true to line and grade, and free of hollows and bumps. Surface shall be dense and smooth.
 - 1. Finished concrete surface for concrete subbases shall be woodfloated to a slightly rough surface. Surface shall not deviate more than 1/4 inch in 10 feet.
 - 2. Finished concrete surfaces shall be wood-floated and steel troweled, or broom finished, to a uniform surface. Surface shall not deviate more than 1/8 inch in 10 feet.
- B. Horizontal surfaces of concrete surfaces which will be exposed shall be given a light broomed finish, with direction of grooves in concrete surface perpendicular to length of concrete band, slab, or pad. After concrete has set sufficiently to prevent coarse aggregate from being torn from surface, but before it has completely set, brooms shall be drawn across the surface to produce a pattern of small parallel grooves. Broomed surface shall be uniform, with no smooth, unduly rough or porous spots, or other irregularities. Coarse aggregate shall not be dislodged by brooming operation.
- C. Immediately following finishing operations, arises at edges and both sides of expansion joints shall be rounded to a 1/4 inch radius. Control joints to be tooled shall be scored into slab surface with scoring tool. Adjacent edges of control joint shall at same time be finished to a 1/4 inch radius.
- D. Where finishing is performed before end of curing period, concrete shall not be permitted to dry out, and shall be kept continuously moist from time of placing until end of curing period, or until curing membrane is applied.
- E. Sidewalk wheelchair ramps shall have a coarse broom finish perpendicular to the direction of travel.

3.08 CURING

- A. Concrete shall be kept continuously damp from time of placement until end of specified curing period or cured by other methods. Water shall not be added to surface during floating and troweling operations, and not earlier than 24 hours after concrete placement. Between finishing operations, surface shall be protected from rapid drying by a covering of waterproofing paper. Surface shall be damp when the covering is placed over it, and shall be kept damp by means of a fog spray of water, applied as often as necessary to prevent drying, but not sooner than 24 hours after

placing concrete. None of the water so applied shall be troweled or floated into surface.

- B. Concrete surfaces shall be cured by completely covering with curing paper or application of a curing compound.
 - 1. Concrete cured using waterproof paper shall be completely covered with paper with seams lapped and sealed with tape. Concrete surface shall not be allowed to become moistened between 24 and 36 hours after placing concrete. During curing period surface shall be checked frequently, and sprayed with water as often as necessary to prevent drying, but not earlier than 24 hours after placing concrete.
 - 2. Concrete cured with a curing compound shall have the compound applied at a rate of 200 square feet per gallon, in two applications perpendicular to each other.
 - 3. Curing period shall be seven days minimum.
- C. Only if additional protection is absolutely required, the surface should remain uncovered after the seven day period for at least 4 days, after which time new and unwrinkled non-staining reinforced waterproof Kraft curing paper may be used.

3.09 EXPANSION JOINTS

- A. Expansion joints shall be 1/2 inch wide and located where shown on the Drawings. Expansion joints shall be troweled in the concrete to required width with preformed joint filler in place. Joint filler shall extend the full depth of the slab and full length of the expansion joint.
 - 1. For concrete walks, pavements, and pads, depth of joint filler shall be placed to form a 1-1/4 inch deep recess for sealant and backer rod below finished concrete surface.
 - 2. Use of multiple pieces to make up required depth and width of joint will not be permitted.

3.10 CONSTRUCTION JOINTS:

- A. Construction joints shall be placed whenever placing of concrete is suspended for more than 30 minutes.
 - 1. Butt joint with dowels or thickened edge joint shall be used if construction joints occur at control joint locations.
 - 2. Keyed joints with tiebars shall be used if the joint occurs at any other location.

3.11 CONTROL JOINTS

- A. Control joints shall be tooled into the concrete slab, with 3-inch wide border and troweled edges, in pattern shown on the Drawings, or every 4 feet o.c. maximum. Joint shall be made after concrete is finished and when the surface is stiff enough to support the weight of workmen without damage to the slab, but before slab has achieved its final set.
- B. Scoring shall cut into slab surface at least 1 inch, but in no case not less than 25 percent of slab depth.

3.12 COLD WEATHER CONCRETING

- A. Materials for concrete shall be heated when concrete is mixed, placed, or cured when the mean daily temperature is below 40°F or is expected to fall to below 40°F within 72 hours. The concrete, after placing, shall be protected by covering, heat, or both.

- B. Details of handling and protecting of concrete during freezing weather shall be subject to the approval and direction of the Engineer. Procedures shall be in accordance with provisions of ACI 306R.

3.13 HOT WEATHER CONCRETING

- A. Concrete just placed shall be protected from the direct rays of the sun and the forms and reinforcement just prior to placing shall be sprinkled with cold water. Every effort shall be made to minimize delays which will result in excessive mixing of the concrete after arrival on the site.
- B. During periods of excessively hot weather (95°F., or above), ingredients in the concrete shall be cooled with cold mixing water to maintain the temperature of the concrete at permissible levels in accordance with the provisions of ACI 305. Any concrete with a temperature above 95°F., when ready for placement, will be rejected.
- C. Temperature records shall be maintained throughout the period of hot weather giving air temperature, general weather conditions (calm, windy, clear, cloudy, etc.) and relative humidity. Records shall include checks on temperature of concrete as delivered and after placing in forms. Data should be correlated with the progress of the work so that conditions surrounding the construction of any part of the structure can be ascertained.

3.14 PROTECTION OF CONCRETE SURFACES

- A. Concrete surfaces shall be protected from traffic or damage until surfaces have hardened sufficiently.

END OF SECTION 03 3010

**SECTION 03 5400
CAST UNDERLAYMENT**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Liquid-applied self-leveling floor underlayment.
 - 1. Use gypsum-based type at all areas..

1.02 REFERENCE STANDARDS

- A. ASTM C1602/C1602M - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete; 2012.
- B. ASTM C472 - Standard Test Methods for Physical Testing of Gypsum, Gypsum Plasters and Gypsum Concrete; 1999 (Reapproved 2014).
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's data sheets documenting physical characteristics and product limitations of underlayment materials. Include information on surface preparation, environmental limitations, and installation instructions.
- C. Manufacturer's Instructions.

1.04 QUALITY ASSURANCE

- A. Applicator Qualifications: Company specializing in performing the work of this section, and approved by manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Keep dry and protect from direct sun exposure, freezing, and ambient temperature greater than 105 degrees F.

1.06 FIELD CONDITIONS

- A. Do not install underlayment until floor penetrations and peripheral work are complete.
- B. Maintain minimum ambient temperatures of 50 degrees F 24 hours before, during and 72 hours after installation of underlayment.
- C. During the curing process, ventilate spaces to remove excess moisture.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Gypsum Underlayment:
 - 1. Maxxon Corporation; Gyp-Crete 2000/3.2K: www.maxxon.com/#sle.
 - 2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 MATERIALS

- A. Gypsum-Based Underlayment: Gypsum based mix, that when mixed with water in accordance with manufacturer's directions will produce self-leveling underlayment with the following properties:
 - 1. Compressive Strength: Minimum 2200 pounds per square inch, tested per ASTM C472.
 - 2. Density: Maximum 110 pounds per cubic foot.
 - 3. Final Set Time: 1 to 2 hours, maximum.

4. Thickness: 3/4 inch to maximum 3-1/2 inch.
 5. Surface Burning Characteristics: Flame spread/Smoke developed index of 0/0 in accordance with ASTM E84.
- B. Aggregate: Dry, well graded, washed silica aggregate, approximately 1/8 inch in size and acceptable to underlayment manufacturer.
 - C. Water: ASTM C1602/C1602M; clean, potable, and not detrimental to underlayment mix materials.
 - D. Primer: Manufacturer's recommended type.
 - E. Joint and Crack Filler: Latex based filler, as recommended by manufacturer.
 - F. Sound Control Mat: Sheet material, perimeter isolation strip, and tape; as recommended by the underlayment manufacturer. Acousti-Mat 1/8" Sound Mat.

2.03 MIXING

- A. Site mix materials in accordance with manufacturer's instructions.
- B. Add aggregate for areas where thickness will exceed 1/2 inch. Mix underlayment and water for at least two minutes before adding aggregate, and continue mixing to assure that aggregate has been thoroughly coated.
- C. Mix to self-leveling consistency without over-watering.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate surfaces are clean, dry, unfrozen, do not contain petroleum byproducts, or other compounds detrimental to underlayment material bond to substrate.

3.02 PREPARATION

- A. Wood: Install metal lath for reinforcement of underlayment.
- B. Remove substrate surface irregularities. Fill voids and deck joints with filler. Finish smooth.
- C. Vacuum clean surfaces.
- D. Prime substrate in accordance with manufacturer's instructions. Allow to dry.
- E. Close floor openings.
- F. Install sound control mat in accordance with manufacturer's instructions.

3.03 APPLICATION

- A. Install underlayment in accordance with manufacturer's instructions.
- B. Place to indicated thickness, with top surface level to 1/8 inch in 10 ft.

3.04 PROTECTION

- A. Protect against direct sunlight, heat, and wind; prevent rapid drying to avoid shrinkage and cracking.
- B. Do not permit traffic over unprotected floor underlayment surfaces.

END OF SECTION

SECTION 04 4253
PREFABRICATED STONE CLADDING PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Exterior prefabricated natural stone veneer wall panels.
- B. Accessories for adhered veneer including stone sills.

1.02 REFERENCE STANDARDS

- A. ASTM C615/C615M - Standard Specification for Granite Dimension Stone; 2011.
- B. ASTM C926 - Standard Specification for Application of Portland Cement-Based Plaster; 2015b.
- C. ASTM C1242 - Standard Guide for Selection, Design, and Installation of Dimension Stone Attachment Systems; 2018a.
- D. ICC (IBC) - International Building Code; 2015.
- E. ACI 530/530.1/ERTA - Building Code Requirements and Specification for Masonry Structures and Related Commentaries; 2011.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on stone units, mortar, and reinforcement.
- C. Samples: Submit two stone samples illustrating minimum and maximum stone sizes, color range, texture, and markings.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing work of the type required by this section, with minimum 5 years of experience.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Protect stone from discoloration during storage on site.
- B. Provide ventilation to prevent condensation from forming on stone.

1.06 FIELD CONDITIONS

- A. Cold Weather Requirements: Comply with requirements of ACI 530/530.1/ERTA or applicable building code, whichever is more stringent.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Prefabricated stone cladding panels:
 - 1. Realstone Systems; Realstonesystems.com.
 - 2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 STONE

- A. Granite: Realstone Systems; complying with ASTM C615/C615M.

2.03 WALL PANELS

- A. Wall Panel Stone Pattern: Estate Stone Collection
- B. Wall Panel Stone Color: TBD
- C. Finish: Rough Cut
- D. Individual Panel Size: 18" x 8"
 - 1. Provide matching fabricated corner units.

- E. Provide matching wainscot / sill cap with integral drip edge.

2.04 MORTAR APPLICATIONS

- A. Provide mortar per manufacturer's recommendations.
 - 1. Pointing Mortars: Pointing or grouting mortars used to fill the joints between individual stone veneer units once the setting bed mortar has sufficiently cured.

2.05 ACCESSORIES - ADHERED VENEER

- A. Expanded Metal Lath: ASTM C847 with ASTM A 653/A G60 (Z180) hot dipped galvanized zinc coating.
 - 1. Diamond Mesh Lath: Self Furring
 - a. Weight 2.5 lbs/sq. yd.
- B. Water Resistive Barrier: Jumbo Tex or equal.
 - 1. Water Vapor Transmission: 10 perms ASTM E96
 - 2. Water Resistance: 20 Minutes; ASTM D779
 - 3. Tensile Strength: 55lb/inch; ASTM D626

2.06 STONE FABRICATION - ADHERED VENEER

- A. Comply with ASTM C1242 requirements for adhered stone system without mechanical anchors for maximum stone weight and maximum individual stone panel size.
- B. Nominal Thickness: 3/4 inch to 1-1/4 inches.
- C. Height: 2 inches to 8 inches.
- D. Length: 6 inches to 14 inches.
- E. Style: As selected by Architect from manufacturer's standard styles.
- F. Fabricate for 3/8 inch beds and joints.
- G. Backs: Sawn.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that support work and site conditions are ready to receive work of this section.
 - 1. Per ASTM C1242, exterior walls to receive thin natural stone veneers should be designed with a stiffness ratio of L/1000 minimum.
- B. Verify that substrates to receive mortar scratch coat or setting bed comply with stone veneer manufacturer's instructions.
 - 1. Metal Lath and Accessories: Verify lath is flat, secured to substrate, and joint and surface perimeter accessories are in place.

3.02 PREPARATION - ADHERED VENEER

- A. Dampen masonry surfaces to reduce excessive suction.
- B. Clean concrete surfaces of foreign matter using approved acid solutions, solvents, or detergents, and then rinse surfaces thoroughly with clean water.
- C. Roughen smooth concrete surfaces and apply bonding compound in accordance with manufacturer's written installation instructions.
- D. Apply dash bond coat to solid bases and moist cure for at least 24 hours before applying setting bed.

3.03 INSTALLATION - WATER-RESISTIVE BARRIER

- A. Where required by thin stone veneer fabricator's instructions or by local codes, install two layers of water-resistive barrier in accordance with water-resistive barrier manufacturer's instructions. Integrate water-resistive barrier with all flashing accessories, adjacent water-resistive barriers, doors, windows, penetrations, and cladding transitions.

- B. Apply water-resistive barrier horizontally with upper layer lapped over lower layer minimum 2 inches.
- C. Lap water-resistive barrier minimum 6 inches at vertical joints.
- D. Lap water-resistive barrier minimum 16 inches past the corner in both directions at inside and outside corners.

3.04 INSTALLATION -METAL LATH

- A. Install expanded metal lath per manufacturer's instructions.

3.05 INSTALLATION - SCRATCH COAT

- A. Apply mortar scratch coat of 1/2 inch nominal to cover metal lath in accordance with ASTM C926. Scratch surface when somewhat firm. If scratch coat dries before applying setting bed mortar and thin stone veneer, moisten scratch coat by misting it with water.

3.06 INSTALLATION - ADHERED VENEER

- A. Install thin stone veneer with a cementitious mortar setting bed to a scratch coat backing surface, in accordance with stone fabricator's instructions and applicable sections of the ICC (IBC), TMS 402/602 and ASTM C1242 that apply to adhered masonry veneer.
- B. Mortar Joints: Concave.
- C. Sills: Install sills where located on drawings.

3.07 INSTALLATION - MASONRY FLASHINGS

- A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.

3.08 CLEANING

- A. Remove excess mortar as work progresses, and upon completion of work.
- B. Replace defective mortar. Match adjacent work.
- C. Clean soiled surfaces with cleaning solution.
- D. Use non-metallic tools in cleaning operations.

END OF SECTION

SECTION 06 1000
ROUGH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Structural dimension lumber framing.
- B. Nonstructural dimension lumber framing.
- C. Rough opening framing for doors, windows, and roof openings.
- D. Sheathing.
- E. Subflooring.
- F. Underlayment.
- G. Roof-mounted curbs.
- H. Roofing nailers.
- I. Preservative treated wood materials.
- J. Miscellaneous framing and sheathing.
- K. Communications and electrical room mounting boards.
- L. Concealed wood blocking, nailers, and supports.
- M. Miscellaneous wood nailers, furring, and grounds.

1.02 RELATED REQUIREMENTS

- A. Section 06 1753 - Shop-Fabricated Wood Trusses.

1.03 REFERENCE STANDARDS

- A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- C. ASTM C557 - Standard Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing; 2003 (Reapproved 2009).
- D. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2014.
- E. ASTM D3498 - Standard Specification for Adhesives for Field-Gluing Wood Structural Panels (Plywood or Oriented Strand Board) to Wood Based Floor System Framing; 2018a.
- F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- G. AWPA U1 - Use Category System: User Specification for Treated Wood; 2012.
- H. ICC-ES AC310 - Water-resistive Membranes Factory-bonded to Wood-based Structural Sheathing, Used as Water-Resistive Barriers; 2015.
- I. PS 1 - Structural Plywood; 2009.
- J. PS 2 - Performance Standard for Wood-Based Structural-Use Panels; 2010.
- K. PS 20 - American Softwood Lumber Standard; 2010.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Structural Composite Lumber: Submit manufacturer's published structural data including span tables, marked to indicate which sizes and grades are being used; if structural composite

lumber is being substituted for dimension lumber or timbers, submit grading agency structural tables marked for comparison.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

1.06 WARRANTY

- A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
 - 1. If no species is specified, provide species graded by the agency specified; if no grading agency is specified, provide lumber graded by grading agency meeting the specified requirements.
 - 2. Grading Agency: Grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee at www.alsc.org, and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.

2.02 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

- A. Sizes: Nominal sizes as indicated on drawings, S4S.
- B. Moisture Content: S-dry or MC19.
- C. Stud Framing (2 by 2 through 2 by 6):
 - 1. Grade: No. 2. SPF, KD
- D. Joist, Rafter, and Small Beam Framing (2 by 6 through 4 by 16):SPF , KD
 - 1. Species: Allowed under grading rules.
 - 2. Grade: No. 2. & Btr, SPF, KD
- E. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
 - 1. Lumber: S4S, No. 2 or Standard Grade.
 - 2. Boards: Standard or No. 3.

2.03 STRUCTURAL COMPOSITE LUMBER

- A. Structural Composite Lumber: Factory fabricated beams, headers, and columns, of sizes and types indicated on drawings; structural capacity as published by manufacturer.
 - 1. Columns: Use parallel strand lumber with manufacturer's published E (modulus of elasticity): 2,000,000 psi, minimum.
 - 2. Beams: Use laminated veneer lumber or parallel strand lumber with manufacturer's published E (modulus of elasticity): 2,000,000 psi, minimum.

2.04 CONSTRUCTION PANELS

- A. Subfloor/Underlayment Combination: Oriented strand board wood structural panel; PS 2, rated Single Floor.
 - 1. Bond Classification: Exposure 1.
 - 2. Performance Category: 23/32 PERF CAT.
 - 3. Structural 1
 - 4. Span Rating: 24.
 - 5. Edges: Tongue and groove.
 - 6. Surface Finish: Fully sanded face.
 - 7. Exposure Time: Sheathing will not delaminate or require sanding due to moisture absorption from exposure to weather for up to 500 days.

8. Warranty: Manufacturer's standard lifetime limited warranty against manufacturing defects and that panels will not delaminate or require sanding due to moisture absorption damage from exposure to weather for up to the stated period.
9. Manufacturers:
 - a. Huber Engineered Woods, LLC; AdvanTech Flooring with AdvanTech Subfloor Adhesive: www.huberwood.com/#sle.
 - b. Substitutions: See Section 01 6000 - Product Requirements.
- B. Subflooring, **Option**: Any PS1 type , APA, rated sheathing
 1. Bond Classification: Exposure 1.
 2. Structural 1
 3. Span Rating: 24.
 4. Performance Category: 23/32 PERF CAT.
- C. Roof Sheathing: Oriented strand board wood structural panel; PS 2.
 1. Grade: Structural 1 Sheathing.
 2. Bond Classification: Exposure 1.
 3. Performance Category: 5/8 PERF CAT.
 4. Exposure Time: Sheathing will not delaminate or require sanding due to moisture absorption from exposure to weather for up to 500 days.
 5. Provide fastening guide on top panel surface with separate markings indicating fastener spacing for 16 inches and 24 inches on center, respectively.
 6. Warranty: Manufacturer's standard lifetime limited warranty against manufacturing defects and that panels will not delaminate or require sanding due to moisture absorption damage from exposure to weather for up to the stated period.
 7. Manufacturers:
 - a. Huber Engineered Woods, LLC; AdvanTech Sheathing: www.huberwood.com/#sle.
- D. Wall Sheathing, For Base Layer, See insulated sheathing below for additional requirements: Oriented strand board structural wood panel with factory laminated water-resistive and air barrier layer.
 1. Sheathing Panel: PS 2, Exposure 1.
 - a. Grade: Sheathing.
 - b. Performance Category: 1/2 PERF CAT.
 - c. Edge Profile: Square edge.
- E. Wall Sheathing, For Fire rated exterior walls: Oriented strand board wood structural panel; PS 2, with factory-applied fire-retardant treatment and fire-resistant cementitious facer.
 1. Grade: Structural 1 Sheathing.
 2. Bond Classification: Exposure 1.
 3. Performance Category: 1/2 PERF CAT.
 4. Edges: Square.
 5. Manufacturers:
 - a. Louisiana-Pacific Corporation; FlameBlock: www.lpcorp.com/#sle.
 - b. Substitutions: See Section 01 6000 - Product Requirements.
- F. Insulated Wall Sheathing, For Community Building: Oriented strand board structural wood panel with factory laminated rigid plastic insulation board, and water-resistive and air barrier layer.
 1. Sheathing Panel: PS 2, Exposure 1.
 2. Insulation Board: Polyisocyanurate (ISO) insulation board; comply with ASTM C1289, Type II, Class 2 - Faced with coated polymer-bonded glass fiber mat facers on both major surfaces of the core foam. **R 6.7@1"insulation and 1/2" sheathing.**
 3. Integral Water-Resistive and Air Barrier: Sheet material qualifying as a Grade D water resistive barrier; complying with ICC-ES AC310.

4. Seam Tape: Manufacturer's standard pressure-sensitive, self-adhering, cold-applied, seam tape. For Zip System.
5. Manufacturers:
 - a. Huber Engineered Woods, LLC; ZIP System R-Sheathing:
www.huberwood.com/#sle. At Community Building.
- G. Wall Sheathing, For Building E and Building F: Polyisocyanurate (ISO) thermal board insulation with Classification indicated, in compliance with ASTM C1289.
 1. Thickness: 3 1/2 inch total minimum thickness. **R 18@3"insualtion and 1/2" sheathing.**
 2. Classifications:
 - a. Type V: Faced with oriented strand board (OSB) or plywood on one major surface of core foam and glass fiber reinforced cellulosic felt or uncoated or coated polymer-bonded glass fiber mat facer on other major surface of core foam.
 - 1) Compressive Strength: 16 psi, minimum.
 3. Manufacturers:
 - a. [GAF ThermaCal Wall Panel]. At Building E and Building F_____.
- H. Communications and Electrical Room Mounting Boards: PS 1 A-D plywood, or medium density fiberboard; 3/4 inch thick; flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.
- I. Exterior Meter Board Mounting: PVC Sheathing Board.

2.05 ACCESSORIES

- A. Fasteners and Anchors:
 1. Metal and Finish: Hot-dipped galvanized steel complying with ASTM A153/A153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.
- B. Joist Hangers: Hot dipped galvanized steel, sized to suit framing conditions.
 1. For contact with preservative treated wood in exposed locations, provide minimum G185 galvanizing complying with ASTM A653/A653M.
- C. Subfloor Adhesives: Waterproof, air cure type, cartridge dispensed; adhesives designed for subfloor applications and complying with either ASTM C557 or ASTM D3498.
 1. Manufacturers:
 - a. Huber Engineered Woods, LLC; AdvanTech Subfloor Adhesive:
www.huberwood.com/#sle.
 - b. Substitutions: See Section 01 6000 - Product Requirements.

2.06 FACTORY WOOD TREATMENT

- A. Treated Lumber and Plywood: Comply with requirements of AWPA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.
 1. Preservative-Treated Wood: Provide lumber and plywood marked or stamped by an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWPA standards.
- B. Preservative Treatment:
 1. Preservative Pressure Treatment of Lumber Above Grade: AWPA U1, Use Category UC3B, Commodity Specification A using waterborne preservative.
 - a. Kiln dry lumber after treatment to maximum moisture content of 19 percent.
 - b. Treat lumber exposed to weather.
 - c. Treat lumber in contact with masonry or concrete.

PART 3 EXECUTION

3.01 PREPARATION

- A. Install sill gasket under sill plate of framed walls bearing on foundations; puncture gasket cleanly to fit tightly around protruding anchor bolts.

- B. Coordinate installation of rough carpentry members specified in other sections.

3.02 INSTALLATION - GENERAL

- A. Select material sizes to minimize waste.
- B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.
- C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

3.03 FRAMING INSTALLATION

- A. Set structural members level, plumb, and true to line. Discard pieces with defects that would lower required strength or result in unacceptable appearance of exposed members.
- B. Make provisions for temporary construction loads, and provide temporary bracing sufficient to maintain structure in true alignment and safe condition until completion of erection and installation of permanent bracing.
- C. Install structural members full length without splices unless otherwise specifically detailed.
- D. Comply with member sizes, spacing, and configurations indicated, and fastener size and spacing indicated, but not less than required by applicable codes and AWI (WFCM) Wood Frame Construction Manual.
- E. Construct double joist headers at floor and ceiling openings and under wall stud partitions that are parallel to floor joists; use metal joist hangers unless otherwise detailed.
- F. Frame wall openings with two or more studs at each jamb; support headers on cripple studs.

3.04 BLOCKING, NAILERS, AND SUPPORTS

- A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.
- B. In framed assemblies that have concealed spaces, provide solid wood fireblocking as required by applicable local code, to close concealed draft openings between floors and between top story and roof/attic space; other material acceptable to code authorities may be used in lieu of solid wood blocking.
- C. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.
- D. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.
- E. Provide the following specific nonstructural framing and blocking:
 - 1. Cabinets and shelf supports.
 - 2. Wall brackets.
 - 3. Handrails.
 - 4. Grab bars.
 - 5. Towel and bath accessories.

3.05 ROOF-RELATED CARPENTRY

- A. Coordinate installation of roofing carpentry with deck construction, framing of roof openings, and roofing assembly installation.
- B. Provide wood curb at all roof openings except where prefabricated curbs are specified and where specifically indicated otherwise. Form corners by alternating lapping side members.

3.06 INSTALLATION OF CONSTRUCTION PANELS

- A. Subflooring/Underlayment Combination: Glue and nail to framing; staples are not permitted.

- B. Wall Sheathing: Secure with long dimension perpendicular to wall studs, with ends over firm bearing and staggered, using nails, screws, or staples.
- C. Communications and Electrical Room Mounting Boards: Secure with screws to studs with edges over firm bearing; space fasteners at maximum 24 inches on center on all edges and into studs in field of board.
 - 1. At fire-rated walls, install board over wall board indicated as part of the fire-rated assembly.
 - 2. Where boards are indicated as full floor-to-ceiling height, install with long edge of board parallel to studs.
 - 3. Install adjacent boards without gaps.
- D. Wall Sheathing and Roof Sheathing with Laminated Water-Resistive Barrier and Air Barrier: Secure to studs as recommended by manufacturer.
 - 1. Install with laminated water-resistive and air barrier on exterior side of sheathing.
 - 2. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.
 - 3. Apply manufacturer's standard seam tape to joints between sheathing panels. Use tape gun or hard rubber roller as recommended by manufacturer.

3.07 TOLERANCES

- A. Framing Members: 1/4 inch from true position, maximum.
- B. Surface Flatness of Floor: 1/8 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.
- C. Variation from Plane, Other than Floors: 1/4 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.

3.08 CLEANING

- A. Waste Disposal: See Section 01 7419 - Construction Waste Management and Disposal.
 - 1. Comply with applicable regulations.
 - 2. Do not burn scrap on project site.
 - 3. Do not burn scraps that have been pressure treated.
 - 4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or "waste-to-energy" facilities.
- B. Do not leave wood, shavings, sawdust, etc. on the ground or buried in fill.
- C. Prevent sawdust and wood shavings from entering the storm drainage system.

END OF SECTION

SECTION 06 1753
SHOP-FABRICATED WOOD TRUSSES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Shop fabricated wood trusses for roof and floor framing.
- B. Bridging, bracing, and anchorage.

1.02 REFERENCE STANDARDS

- A. ANSI/TPI 1 - National Design Standard for Metal-Plate-Connected Wood Truss Construction; 2014.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- C. TPI 1 - National Design Standard for Metal-Plate-Connected Wood Truss Construction; 2007 and errata.
- D. TPI BCSI 1 - Building Component Safety Information Booklet: The Guide to Good Practice for Handling, Installing & Bracing of Metal Plate Connected Wood Trusses; 2011.
- E. TPI DSB-89 - Recommended Design Specification for Temporary Bracing of Metal Plate Connected Wood Trusses; 1989.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's data sheets on plate connectors, bearing plates, and metal bracing components.
- C. Shop Drawings: Show truss configurations, sizes, spacing, size and type of plate connectors, cambers, framed openings, bearing and anchor details, and bridging and bracing.
 - 1. Include identification of engineering software used for design.
 - 2. Provide shop drawings stamped or sealed by design engineer.

1.04 QUALITY ASSURANCE

- A. Designer Qualifications: Perform design by or under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in the State in which the Project is located.
- B. Fabricator Qualifications: Company specializing in manufacturing the products specified in this section with minimum ten years of documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Handle and erect trusses in accordance with TPI BCSI 1.
- B. Store trusses in vertical position resting on bearing ends.

PART 2 PRODUCTS

2.01 TRUSSES

- A. Wood Trusses: Designed and fabricated in accordance with ANSI/TPI 1 and TPI DSB-89 to achieve structural requirements indicated.
 - 1. Floor Truss Loading: Live Load = 40 lbs/sq. ft., Top Chord Dead Load = 15 lbs/sq. ft., Bottom Chord Dead load = 10 lbs /sq. ft.
 - 2. Roof Truss Loading: Snow Load = 30 lbs / sq. ft. with drifting as required by ASCE 7, Top Chord Dead Load = 25 lbs / sq. ft., Bottom Chord Dead Load = 10 lbs / sq.ft.
 - 3. Floor Deflection: L/480 for live loads, L/360 for dead loads.
 - 4. Roof Deflection: L/360 for live loads, L/240 for dead loads

5. Top chord to be sloped from front to back 1/4" per foot for drainage at **roof trusses only.**

2.02 MATERIALS

- A. Lumber:
 1. Moisture Content: Between 7 and 9 percent.
 2. Lumber fabricated from old growth timber is not permitted.
- B. Steel Connectors: Hot-dipped galvanized steel sheet, ASTM A653/A653M Structural Steel (SS) Grade 33/230, with G90/Z275 coating; die stamped with integral teeth; thickness as indicated.
- C. Truss Bridging: Type, size and spacing recommended by truss manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that supports and openings are ready to receive trusses.

3.02 PREPARATION

- A. Coordinate placement of bearing items.

3.03 ERECTION

- A. Install trusses in accordance with manufacturer's instructions and TPI DSB-89 and TPI BCSI 1; maintain a copy of each TPI document on site until installation is complete.
- B. Set members level and plumb, in correct position.
- C. Do not field cut or alter structural members without approval of Architect.
- D. Install permanent bridging and bracing.
- E. Coordinate placement of decking with work of this section.

3.04 TOLERANCES

- A. Framing Members: 1/2 inch maximum, from true position.

END OF SECTION

SECTION 06 2000
FINISH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Finish carpentry items.
- B. **Wood casings and moldings. Alternate #ARC-2**

1.02 REFERENCE STANDARDS

- A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014.
- B. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.0; 2016.
- C. PS 1 - Structural Plywood; 2009.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide Wood Trim and casing product data.
 - 1. Provide data on wood structural adhesive paste and wood consolidant.

1.04 QUALITY ASSURANCE

- A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Protect from moisture damage.

PART 2 PRODUCTS

2.01 FINISH CARPENTRY ITEMS

- A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
- B. Exterior Woodwork Items:
 - 1. Moldings and Trims: Azek (Solid Cellular PVC) or equal, painted finish.
 - 2. Soffits and Fascias: Azek (Solid Cellular PVC) Trim or equal, painted finish.
- C. Interior Woodwork Items:
 - 1. Moldings, Bases, Casings, and Miscellaneous Trim: Primed finger jointed pine or poplar; prepare for paint finish.
 - 2. Loose Shelving: See Section 10 5723 Closet & Utility Shelving

2.02 LUMBER MATERIALS

- A. Softwood Lumber: Finger Jointed Pine or Poplar species, plain sawn, maximum moisture content of 6 percent; with flat grain, paint grade.

2.03 SHEET MATERIALS

- A. Softwood Plywood, Not Exposed to View: Any face species, medium density fiberboard core; PS 1 Grade A-B, glue type as recommended for application.
- B. Softwood Plywood, Exposed to View: Face species as indicated, plain sawn, medium density fiberboard core; PS 1 Grade A-B, glue type as recommended for application.

2.04 FASTENINGS

- A. Adhesive for Purposes Other Than Laminate Installation: Suitable for the purpose; not containing formaldehyde or other volatile organic compounds.

- B. Fasteners: Of size and type to suit application; plain finish in concealed locations and colored finish in exposed locations.

2.05 ACCESSORIES

- A. Lumber for Shimming, Blocking, and misc: Softwood lumber of any species.
- B. Cellular PVC Trim and Moldings: Extruded, expanded PVC; UV-resistant, heat-stabilized, and rigid material; for exterior use only.
 - 1. Manufacturers:
 - a. AZEK Building Products, Inc; Traditional Trim: www.azek.com/#sle.
 - b. Substitutions: See Section 01 6000 - Product Requirements.
- C. Wood Filler: Solvent base, tinted to match surface finish color.

2.06 FABRICATION

- A. Shop assemble work for delivery to site, permitting passage through building openings.
- B. Cap exposed plastic laminate finish edges with material of same finish and pattern.
- C. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.

2.07 SHOP FINISHING

- A. Sand work smooth and set exposed nails and screws.
- B. Apply wood filler in exposed nail and screw indentations.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify adequacy of backing and support framing.

3.02 INSTALLATION

- A. Install custom fabrications in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade indicated.
- B. Set and secure materials and components in place, plumb and level.
- C. Carefully scribe work abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim to conceal larger gaps.

3.03 SCHEDULE

- A. Exterior
 - 1. See drawings
- B. Interior
 - 1. See drawings
 - a. Window casing: 1 1/16" x 3 1/2" WM412 Primed Pine , Provide traditional sill
 - b. Door Casing: 1 1/16" x 3 1/2" WM412 Primed Pine
 - c. Wall Base: 9/16" x 5 1/4" SAN 525 Primed Pine **Alternate ARC #2**

END OF SECTION

**SECTION 06 5300
PLASTIC DECKING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Plastic decking.

1.02 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product, including:
 - 1. Preparation instructions.
 - 2. Storage and handling requirements.
 - 3. Installation methods.
- C. Samples: Submit two samples, 6 by 6 inch in size illustrating texture and finish.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store products in manufacturer's unopened packaging bearing the brand name and manufacturer's identification until ready for installation.
- B. Comply with manufacturer's recommendations. Handle materials to avoid damage.

1.05 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide manufacturer's standard limited warranty for products.
 - 1. Decking Warranty: Provide manufacturer's standard min. 25 year warranty for residential applications.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Plastic Decking:
 - 1. Trex, Timbertech, or Fiberon.
 - 2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PLASTIC DECKING

- A. Plastic Decking: Capped cellular PVC plastic with no cellulose fiber molded into shapes in standard deck board sizes and profiles; for exterior use only.
 - 1. Size: Decking: 1 by 3-1/2 inches, actual.
 - 2. Board Length: 12 feet.
 - 3. Texture: Molded, wood grain.
 - 4. Color: To be selected by Architect from manufacturer's full range.
 - 5. Edges, Field Boards: Tongue and groove.
 - 6. Edges, Perimeter Boards: Tongue and groove one edge; bullnose on the other.

2.03 ACCESSORIES

- A. Fasteners and Anchors:

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that support framing is ready to receive decking.

- B. Standard Installation: Confirm joists are spaced at 12 inches on center maximum, and are sloped at a minimum of 1/4 inch per foot away from the building.

3.02 PREPARATION

- A. Coordinate placement of bearing items.

3.03 INSTALLATION

- A. General: Install products in accordance with manufacturer's published installation instructions, and applicable ICC-ES report.
- B. Install decking with ends staggered over firm bearing. On sloped surfaces, lay decking with tongue upward.
- C. Engage decking tongue and groove edges.
- D. Secure with manufacturer's proprietary fastener system.

3.04 CLEANING

- A. See Section 01 7419 - Construction Waste Management and Disposal, for additional requirements.

3.05 PROTECTION

- A. Protect installed work from subsequent construction operations. Repair damaged surfaces. Remove and replace work which cannot be repaired.

END OF SECTION

SECTION 06 6300
PLASTIC RAILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Exterior balcony railings and guardrails.

1.02 REFERENCE STANDARDS

- A. ASTM B429/B429M - Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube; 2010.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store products in manufacturer's unopened packaging bearing the brand name and manufacturer's identification until ready for installation.
- B. Comply with manufacturer's recommendations. Handle materials to avoid damage.

1.05 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Railing Warranty: Provide manufacturer's standard 10 year warranty.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Plastic Handrails and Railings:
 - 1. Azek Building Products, Inc; Premier Rail: www.azek.com/#sle.
 - 2. Wolf Home Products; Wolf Distinction Railing: www.wolfhomeproducts.com/#sle.

2.02 PLASTIC GUARDRAIL SYSTEMS

- A. Performance Requirements:
 - 1. Distributed Loads: Design railing assembly, wall rails, and attachments to resist distributed force of [50] pounds per linear foot applied to the top of the assembly and in any direction, without damage or permanent set, when tested in accordance with ASTM D7032.
 - 2. Concentrated Loads: Design railing assembly, wall rails, and attachments to resist a concentrated force of 200 pounds applied at any point on the top of the assembly and in any direction, without damage or permanent set, when tested in accordance with ASTM D7032.
- B. Design Requirements:
 - 1. Allow for expansion and contraction of members and building movement without damage to connections or members.
 - 2. Provide anchors and other components as required to attach to structure; where exposed fasteners are unavoidable provide flush countersunk fasteners.
- C. Plastic Rails:
 - 1. Top Rail: Capped cellular PVC over extruded aluminum support rail.
 - 2. Bottom Rail: Capped cellular PVC over extruded aluminum support rail.
- D. Plastic Newel Posts: Provide post mounts, caps, and trim required for the installation.
 - 1. Post Size: 4 by 4 inch.
 - 2. Post Cap Style: Pyramid.

- E. Railing Infill:
 - 1. Baluster:
 - a. Material: Plastic.
 - b. Profile: Square.
- F. Texture: Smooth, matte.
- G. Color: White.
- H. Exposed Fasteners: No exposed bolts or screws.

2.03 MATERIALS

- A. Plastic Railing Components: Capped cellular PVC plastic with no cellulose fiber molded into solid shapes in standard railing sizes and profiles.
- B. Aluminum: Support rails and pickets: Aluminum extrusions; alloy and temper 6063-T6 complying with ASTM B429/B429M.

2.04 ACCESSORIES

- A. Fasteners and Anchors:
 - 1. Fasteners: Stainless steel, trim head.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that railing locations and substrates are ready to receive work.

3.02 INSTALLATION

- A. Install according to manufacturer's written instructions, and applicable ICC-ES report.
- B. Install components plumb and level, accurately fitted, free from distortion or defects, with tight joints.
- C. Anchor railings securely to structure.

3.03 CLEANING

- A. See Section 01 7419 - Construction Waste Management and Disposal, for additional requirements.
- B. Clean surfaces according to manufacturer's written instructions.

3.04 PROTECTION

- A. Protect installed work from subsequent construction operations. Repair damaged surfaces. Remove and replace work which cannot be repaired.

END OF SECTION

**SECTION 07 1113
BITUMINOUS DAMPPROOFING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Bituminous dampproofing at elevator pit locations.

1.02 REFERENCE STANDARDS

- A. ASTM D1187/D1187M - Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal; 1997 (Reapproved 2011).
- B. ASTM D1227/D1227M - Standard Specification for Emulsified Asphalt Used as a Protective Coating for Roofing; 2019.
- C. ASTM D1227 - Standard Specification for Emulsified Asphalt Used as a Protective Coating for Roofing; 2013.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide properties of primer, bitumen, and mastics.
- C. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

1.04 FIELD CONDITIONS

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

PART 2 PRODUCTS

2.01 BITUMINOUS DAMPPROOFING

- A. 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.
 - 1. Composition - Vertical Application: ASTM D1227/D1227M Type III or ASTM D1187/D1187M Type I.
 - 2. VOC Content: Not more than permitted by local, State, and federal regulations.
 - 3. Applied Thickness: 1/16 inch, minimum, wet film.
 - 4. Products:
 - a. W.R. Meadows, Inc.; Sealastic Emulsion Type II (brush/spray-grade): www.wrmeadows.com.
 - b. Substitutions: See Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 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.

3.02 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.

3.03 APPLICATION

- A. Elevator pit walls: Apply two coats of asphalt dampproofing.
- B. Apply bitumen by manufacturer's recommended devices.
- C. Seal items watertight with mastic, that project through dampproofing surface.
- D. Install insulation immediately after applying bitumen

END OF SECTION

SECTION 07 2100
THERMAL INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Board insulation at perimeter foundation wall and underside of floor slabs. as detailed at new construction
- B. Batt Acoustic Insulation
- C. Foam insulation for filling perimeter window and door shim spaces and crevices in exterior wall and roof.

1.02 RELATED REQUIREMENTS

- A. Section 07 2119 - Foamed-In-Place Insulation: Plastic foam insulation other than boards.
- B. Section 07 2129 - Sprayed Insulation: Sprayed-on, adhered fibrous insulation.

1.03 REFERENCE STANDARDS

- A. Energy Star Qualified Homes, Technical Standards, Version 3.0
- B. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2015a.
- C. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2012.
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- E. ASTM E136 - Standard Test Method for Behavior of Materials in a Vertical Tube Furnace At 750 Degrees C; 2012.
- F. PHIUS + 2018

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.

1.05 FIELD CONDITIONS

- A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

PART 2 PRODUCTS

2.01 APPLICATIONS

- A. Insulation Under Concrete Slabs: Extruded polystyrene (XPS) board.
- B. Acoustic Insulation at Interior Walls: Batt insulation.
- C. **Insulation in Wood Framed Walls: (See Section 072129 for sprayed cellulose)**
- D. **Exterior insulation Board:(See Section 061000 Rough Carpentry.**
- E. Insulation over roof deck: Specified under Section 075300 Elastomeric Membrane Roofing

2.02 FOAM BOARD INSULATION MATERIALS

- A. Extruded Polystyrene (XPS) Board Insulation: Complies with ASTM C578 with either natural skin or cut cell surfaces.
 - 1. Type and Compressive Resistance: Type IV, 25 psi (173 kPa), minimum.
 - 2. Type and Compressive Resistance: Type VI, 40 psi (276 kPa), minimum under interior footings

3. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
4. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
5. Board Edges: Square.
6. Thermal Resistance: R-20 at 4" total thickness. R5 / inch

2.03 BATT INSULATION MATERIALS

- A. Acoustic Insulation: ASTM C665; preformed glass fiber, friction fit type, unfaced. Thickness: [3 1/2] inch.

2.04 ACCESSORIES

- A. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.
- B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

3.02 BOARD INSTALLATION UNDER CONCRETE SLABS

- A. Place insulation under slabs on grade after base for slab has been compacted.
- B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.
- C. Prevent insulation from being displaced or damaged while placing vapor retarder and placing slab.
- D. **There should be no visible gaps between insulation boards. Gaps shall be filled with spray foam insulation.**

3.03 ACOUSTIC BATT INSTALLATION

- A. Install insulation in accordance with manufacturer's instructions.
- B. Install in wall and ceiling spaces without gaps or voids. Do not compress insulation.
- C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
- D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.

3.04 FIELD QUALITY CONTROL

- A. **Field Inspections shall be by Owner's Representative to verify compliance with Energy Star and Passive House Standards.**
- B. **Corrective measures due to improper installation will be the responsibility of the Contractor at no additional expense to the Owner.**

END OF SECTION

SECTION 07 2119
FOAMED-IN-PLACE INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Foamed-in-place insulation.
 - 1. At roof rafters in non-accessible attics
 - 2. At exterior walls of bathroom spaces and behind exterior tub walls.
 - 3. In exterior wall crevices.
- B. Protective intumescent coating.

1.02 REFERENCE STANDARDS

- A. Energy Star Homes Technical Guidelines Ver 3.1
- B. PHIUS + 2018
- C. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2010.
- D. ASTM D2842 - Standard Test Method for Water Absorption of Rigid Cellular Plastics; 2012.
- E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- F. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2014.
- G. ASTM E2178 - Standard Test Method for Air Permeance of Building Materials; 2013.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide product description, insulation properties, overcoat properties, and preparation requirements.
- C. Manufacturer Qualification: Submit documentation of current evaluation of proposed manufacturer and materials.
- D. Installer Qualification: Submit documentation of current contractor accreditation and current installer certification. Keep copies of all contractor accreditation and installer certification on site during and after installation. Present on-site documentation upon request.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with not less than three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified, with minimum three years documented experience, and approved by manufacturer.

1.05 FIELD CONDITIONS

- A. Do not apply foam when temperature is below that specified by the manufacturer for ambient air and substrate.
- B. Do not apply foam when temperature is within 5 degrees F of dew point.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Foamed-In-Place Insulation:
 - 1. Icynene-Lapolla; Icynene ProSeal (MD-C-200 v3): www.icynene.com/#sle.
 - 2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 MATERIALS

- A. Foamed-In-Place Insulation: Medium-density, rigid or semi-rigid, closed cell polyurethane foam; foamed on-site, using blowing agent of water or non-ozone-depleting gas.
1. Regulatory Requirements: Comply with applicable code for flame and smoke, concealment, and overcoat limitations.
 2. Thermal Resistance: R-value of 7, minimum, per 1 inch thickness at 75 degrees F mean temperature when tested in accordance with ASTM C518. **Provide thickness to achieve R-56 at building A and R-38 at Building B. This combined with above deck insulation will give a total R-Value of R-78 at Building A and R-60 at Building B**
 3. **R-38 at Community Building.**
 4. Water Vapor Permeance: Vapor retarder; 2 perms, maximum, when tested at intended thickness in accordance with ASTM E96/E96M, desiccant method.
 5. Water Absorption: Less than 2 percent by volume, maximum, when tested in accordance with ASTM D2842.
 6. Air Permeance: 0.04 cfm per square foot, maximum, when tested at intended thickness in accordance with ASTM E2178 at 1.57 psf.
 7. Closed Cell Content: At least 90 percent.
 8. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/450, maximum, when tested in accordance with ASTM E84.
 9. Basis of Design:
 - a. Icynene-Lapolla; Icynene ProSeal LE: www.icynene.com/#sle.

2.03 ACCESSORIES

- A. Protective Coating: Intumescent coating of type recommended by insulation manufacturer and as required to comply with applicable codes.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify work within construction spaces or crevices is complete prior to insulation application.
- B. Verify that surfaces are clean, dry, and free of matter that may inhibit insulation or overcoat adhesion.

3.02 PREPARATION

- A. Mask and protect adjacent surfaces from over spray or dusting.
- B. Apply primer in accordance with manufacturer's instructions.

3.03 APPLICATION

- A. Apply insulation in accordance with manufacturer's instructions.
- B. Apply insulation by spray method, to a uniform monolithic density without voids.
- C. Apply to achieve a thermal resistance R-value of R-38 at the underside of the roof deck at Building A and the community building, and R-54 at the underside of the roof deck at Building B..
- D. Where applied to voids and gaps assure space for expansion to avoid pressure on adjacent materials that may bind operable parts.
- E. Trim excess away for applied trim or remove as required for continuous sealant bead.

3.04 FIELD QUALITY CONTROL

- A. **Field Inspections shall be by Owner's Representative to verify compliance with Energy Star and Passive House Standards.**
- B. **Corrective measures due to improper installation will be the responsibility of the Contractor at no additional expense to the Owner.**

3.05 PROTECTION

- A. Do not permit subsequent construction work to disturb applied insulation.

END OF SECTION

**SECTION 07 2129
SPRAYED INSULATION**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Cellulose insulation placed in walls.

1.02 REFERENCE STANDARDS

- A. Energy Star Homes Technical Guidelines Ver 3.1
- B. PHIUS + 2018
- C. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2013.
- D. ASTM C739 - Standard Specification for Cellulosic Fiber (Wood-Base) Loose-Fill Thermal Insulation; 2011.
- E. ASTM D1622 - Standard Test Method for Apparent Density of Rigid Cellular Plastics; 2020.
- F. ASTM D1622/D1622M - Standard Test Method for Apparent Density of Rigid Cellular Plastics; 2014.
- G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on materials, describing insulation properties.
- C. Manufacturer's Qualification Statement.
- D. Installer's Qualification Statement.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.05 FIELD CONDITIONS

- A. Do not install insulation, sealer when ambient and surface temperatures are lower than 40 degrees F.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Cellulosic Fiber Sprayed Insulation:
 - 1. GreenFiber: www.greenfiber.com.
 - 2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 MATERIALS

- A. Cellulosic Fiber Insulation: ASTM C739; treated cellulosic fiber, white color.
 - 1. Thermal Resistance (R-value): 3.7, at 1 inch thick when tested in accordance with ASTM C177 at 75 degrees F temperature. R
 - 2. Density: 2 lb/cu ft, when tested in accordance with ASTM D1622.
 - 3. Flame Spread / Smoke Developed Index: 0-25 / 0-450, Class A, when tested in accordance with ASTM E84.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are clean, dry, and free of matter that may inhibit adhesion.
- B. Verify that ceiling hangers and supporting clips have been installed correctly.
- C. Verify other work on and within spaces to be insulated is complete prior to application.

3.02 PREPARATION

- A. Mask and protect adjacent surfaces from overspray or damage.
- B. Apply primer in accordance with manufacturer's instructions.

3.03 INSTALLATION

- A. Install sprayed insulation in accordance with manufacturer's instructions.
- B. Install insulation to a uniform monolithic density without voids. **The spray insulation within the wall cavity must achieve a minimum R-Value of R-19.**

3.04 FIELD QUALITY CONTROL

- A. **Field Inspections shall be by Owner's Representative to verify compliance with Energy Star and Passive House standards.**
- B. **Corrective measures due to improper installation will be the responsibility of the Contractor at no additional expense to the Owner.**

3.05 PROTECTION

- A. Do not permit subsequent construction work to disturb applied sprayed insulation.

END OF SECTION

**SECTION 07 2500
WEATHER BARRIERS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Water-Resistive Barrier: Under exterior wall cladding, over sheathing or other substrate; not air tight or vapor retardant.
- B. Vapor Retarders: Materials to make exterior walls, joints between exterior walls and roof, and joints around frames of openings in exterior walls water vapor resistant and air tight.
- C. Air Barriers: Materials that form a system to stop passage of air through exterior walls, joints between exterior walls and roof, and joints around frames of openings in exterior walls.

1.02 DEFINITIONS

- A. Weather Barrier: Assemblies that form either water-resistive barriers, air barriers, or vapor retarders.
- B. Air Barrier: Air tight barrier made of material that is relatively air impermeable but water vapor permeable, both to the degree specified, with sealed seams and with sealed joints to adjacent surfaces. Note: For the purposes of this specification, vapor impermeable air barriers are classified as vapor retarders.
- C. Vapor Retarder: Air tight barrier made of material that is relatively water vapor impermeable, to the degree specified, with sealed seams and with sealed joints to adjacent surfaces.
- D. Water-Resistive Barrier: Water-shedding barrier made of material that is moisture resistant, to the degree specified, intended to be installed to shed water without sealed seams.

1.03 REFERENCE STANDARDS

- A. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection; 2013.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- C. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2014.
- D. ASTM E2178 - Standard Test Method for Air Permeance of Building Materials; 2013.
- E. ICC-ES AC308 - Acceptance Criteria for Water-Resistive Barriers; ICC Evaluation Service, Inc; 2013.
- F. PHIUS + 2018

1.04 QUALITY ASSURANCE

- A. **The complete air barrier system will be subject to compliance with the PHIUS+ 2018 air tightness testing standard.**
- B. **Each building must achieve a whole building air tightness of 0.06 CFM/sf of exterior envelope area at 50 Pascals (the average value of pressurization is used for compliance)**
- C. **The testing will be performed by the Owner's Passive House Verifier.**
- D. **Intermediate air leakage spot testing will also be performed by the Owner's Passive House Consultant for quality control of the air barrier installation during construction.**

PART 2 PRODUCTS

2.01 WEATHER BARRIER ASSEMBLIES

- A. Water-Resistive Barrier: Provide on Exterior walls behind stone cladding.
- B. Air Barrier:

1. On outside surface of insulated sheathing of exterior walls of Building C and D use air barrier sheet, self-adhesive type.
2. **Air Barrier integral with Sheathing (See Section 061000 ROUGH CARPENTRY) at Community Building.**

C. Interior Vapor Retarder: Class III

1. **Paint applied to interior gypsum board with a perm rating of greater than 1.0 and less than 10.0**

2.02 WATER-RESISTIVE BARRIER MATERIALS (NEITHER AIR BARRIER OR VAPOR RETARDER) AT STONE VENEER

A. Building Paper: Asphalt-saturated Kraft building paper complying with requirements of ICC-ES AC308 Grade D.

1. Manufacturers:
 - a. Fortifiber Building Systems Group; Classic: Fortafiber / Jumbo Tex:
www.fortifiber.com/#sle.

2.03 AIR BARRIER MATERIALS (WATER VAPOR PERMEABLE AND WATER-RESISTIVE)

A. Air Barrier Sheet, Self-Adhered: At Buildings C and D.

1. Air Permeance: 0.004 cfm/sq ft, maximum, when tested in accordance with ASTM E2178.
2. Water Vapor Permeance: 10 perms, minimum, when tested in accordance with ASTM E96/E96M Procedure A (Desiccant Method) at 73.4 degrees F.
3. Ultraviolet (UV) and Weathering Resistance: Approved in writing by manufacturer for up to 90 days of weather exposure.
4. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less (Class A), when tested in accordance with ASTM E84.
5. Seam and Perimeter Tape: As recommended by sheet manufacturer.
6. Manufacturers:
 - a. Henry Company; Blueskin VP160: www.henry.com/#sle.

2.04 ACCESSORIES

A. Sealants, Tapes, and Accessories for Sealing Weather Barrier and Sealing Weather Barrier to Adjacent Substrates: As specified or as recommended by weather barrier manufacturer.

B. Flexible Flashing: Self-adhesive sheet flashing complying with ASTM D1970/D1970M, except slip resistance requirement is waived if not installed on a roof.

1. Thickness: 25 mil, .025 inch, nominal; exception from ASTM D1970/D1970M.
2. Manufacturers:
 - a. Vycor Plus.
 - b. Substitutions: See Section 01 6000 - Product Requirements.

C. Sill Plate Sealer: Closed-cell foam tape with rubberized adhesive membrane; bridges gap between foundation structure and sill plate or skirt board.

1. Width: 3-1/2 inches.
2. Ultraviolet (UV) and Weathering Resistance: Approved in writing by manufacturer for up to 30 days of weather exposure.
3. Manufacturers:
 - a. Protecto Wrap Company; Triple Guard Energy Sill Sealer:
www.protectowrap.com/#sle.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces and conditions are ready to accept the work of this section.

3.02 PREPARATION

- A. Remove projections, protruding fasteners, and loose or foreign matter that might interfere with proper installation.

3.03 INSTALLATION

- A. Install materials in accordance with manufacturer's instructions.
- B. Water-Resistive Barriers: Install continuous barrier over surfaces indicated, with sheets lapped to shed water but with seams not sealed.
- C. Openings, Behind corner boards, and Penetrations in Exterior Weather Barriers:
 - 1. Install flashing over sills, covering entire sill frame member, extending at least 5 inches onto weather barrier and at least 6 inches up jambs; mechanically fasten stretched edges.
 - 2. At openings to be filled with frames having nailing flanges, seal head and jamb flanges using a continuous bead of sealant compressed by flange and cover flanges with sealing tape at least 4 inches wide; do not seal sill flange.
 - 3. At openings to be filled with non-flanged frames, seal weather barrier to each side of opening framing, using flashing at least 9 inches wide, covering entire depth of framing.
 - 4. At head of openings, install flashing under weather barrier extending at least 2 inches beyond face of jambs; seal weather barrier to flashing.
 - 5. Service and Other Penetrations: Form flashing around penetrating item and seal to weather barrier surface.
 - 6. Install behind corner boards extending tape min. 3 Inches beyond edge of corner board.

3.04 PROTECTION

- A. Do not leave materials exposed to weather longer than recommended by manufacturer.
- B. Do not leave paper- or felt-based barriers exposed to weather for longer than one week.

END OF SECTION

SECTION 07 3113
ASPHALT SHINGLES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Asphalt shingle roofing.
- B. Flexible sheet membranes for eave protection and roof wall intersections.
- C. Associated metal flashings and accessories.

1.02 REFERENCE STANDARDS

- A. ASTM D226/D226M - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing; 2009.
- B. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection; 2013.
- C. ASTM D3462 - Standard Specification for Asphalt Shingles Made From Glass Felt and Surfaced with Mineral Granules; 2010a.
- D. ASTM F1667 - Standard Specification for Driven Fasteners: Nails, Spikes, and Staples; 2013.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data indicating material characteristics.
- C. Samples: Submit one samples of each shingle color indicating color range and finish texture/pattern; for color selection.
- D. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.04 FIELD CONDITIONS

- A. Do not install shingles or eave protection membrane when surface temperatures are below 45 degrees F.

1.05 WARRANTY

- A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.
- B. Provide min. 50 year min. warranty on shingles.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Asphalt Shingles:
 - 1. NRCA (RM) - The NRCA Roofing Manual; 2017.
 - 2. GAF; Timberline HD Reflector Series: www.gaf.com/#sle.
 - 3. Certainteed ; Product Landmark.
 - 4. Substitutions: See Section 01 6000 - Product Requirements.

2.02 ASPHALT SHINGLES

- A. Asphalt Shingles: Asphalt-coated glass felt, mineral granule surfaced, complying with ASTM D3462; Class A fire resistance. **Shingles to carry min. 50 year warranty.**
 - 1. Self-sealing type.
 - 2. Style: Laminated overlay.
 - 3. Color: As selected by Architect.

2.03 SHEET MATERIALS

- A. Eave Protection Membrane: Self-adhering polymer-modified asphalt sheet complying with ASTM D1970/D1970M; 40 mil total thickness; with strippable treated release paper and polyethylene sheet top surface.
- B. Underlayment: Asphalt-saturated organic roofing felt, unperforated, complying with ASTM D226/D226M, Type I ("No.15").

2.04 ACCESSORIES

- A. Roofing Nails: Standard round wire shingle type, galvanized steel, stainless steel, aluminum roofing nails, or copper roofing nails, minimum 3/8 inch head diameter, 12 gauge, 0.109 inch nail shank diameter, 1-1/2 inch long and complying with ASTM F1667.

2.05 METAL FLASHINGS

- A. Metal Flashings: Provide sheet metal eave edge, gable edge, dormer flashing, and other flashing indicated.
 - 1. Form flashings to profiles indicated on drawings.
 - 2. Form sections square and accurate to profile, in maximum possible lengths, free from distortion or defects detrimental to appearance or performance.
- B. Aluminum Sheet Metal: Prefinished aluminum, 26 gauge, 0.017 inch minimum thickness; no coating, mill finish color.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions prior to beginning work.
- B. Verify that roof deck is of sufficient thickness to accept fasteners.
- C. Verify that roof penetrations and plumbing stacks are in place and flashed to deck surface.
- D. Verify roof openings are correctly framed.
- E. Verify deck surfaces are dry, free of ridges, warps, or voids.

3.02 PREPARATION

- A. Seal roof deck joints wider than 1/16 inch as recommended by shingle manufacturer.
- B. At areas where eave protection membrane is to be adhered to substrate, fill knot holes and surface cracks with latex filler.
- C. Broom clean deck surfaces before installing underlayment or eave protection.
- D. Install eave edge flashings tight with fascia boards. Weather lap joints 2 inches and seal with plastic cement. Secure flange with nails spaced 8 inches on center.

3.03 INSTALLATION - EAVE PROTECTION MEMBRANE

- A. Install eave protection membrane from eave edge to minimum 3' ft up-slope beyond interior face of exterior wall. See drawings for additional requirements.
- B. Install eave protection membrane in accordance with manufacturer's instructions and NRCA (RM) applicable requirements.

3.04 INSTALLATION - MEMBRANE AT ROOF WALL INTERSECTIONS

- A. Install eave protection membrane at intersection of roof surface and vertical wall. Extend membrane 36" at each surface. Install prior to any additional flashings specified.

3.05 INSTALLATION - UNDERLAYMENT

- A. Underlayment At Roof Slopes Greater Than 4:12: Install underlayment perpendicular to slope of roof, with ends and edges weather lapped minimum 4 inches, stagger end laps of each consecutive layer, nail in place, and weather lap minimum 4 inches over eave protection.

- B. Weather lap and seal watertight with plastic cement any items projecting through or mounted on roof.

3.06 INSTALLATION - VALLEY PROTECTION

- A. Instal Eave Protection Membrane at centerline of valley
- B. Weather lap joints minimum 2 inches.
- C. Nail in place minimum 18 inches on center, 1 inch from edges.

3.07 INSTALLATION - METAL FLASHING AND ACCESSORIES

- A. Weather lap joints minimum 2 inches and seal weather tight with plastic cement.
- B. Secure in place with nails at 10 inches on center, and conceal fastenings.
- C. Items Projecting Through or Mounted on Roofing: Flash and seal weather tight with plastic cement.
- D. **Any metal flashing that is intended to be installed in a manner that penetrates an insulation layer must be reviewed and approved by the Owner's Passive House Consultant.**

3.08 INSTALLATION - SHINGLES

- A. Install shingles in accordance with manufacturer's instructions manufacturer's instructions and NRCA (RM) applicable requirements.
 - 1. Fasten individual shingles using two nails per shingle, or as required by manufacturer and local building code, whichever is greater.
 - 2. Fasten strip shingles using 6 nails per strip, or as required by code, whichever is greater.
- B. Place shingles in straight coursing pattern with 5 inch weather exposure to produce double thickness over full roof area, and provide double course of shingles at eaves.
- C. Project first course of shingles 3/4 inch beyond fascia boards.
- D. Extend shingles 1/2 inch beyond face of gable edge fascia boards.
- E. Complete installation to provide weather tight service.

END OF SECTION

SECTION 07 4633
PLASTIC SIDING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Plastic siding and trim.
- B. Thermoplastic polyolefin shingles and shakes.
- C. See Section 07 4646 Fiber Cement Siding for Alternate Product #ARC-1

1.02 REFERENCE STANDARDS

- A. ASTM D3679 - Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Siding; 2013.
- B. ASTM D4477 - Standard Specification for Rigid (Unplasticized) Poly(Vinyl Chloride) (PVC) Soffit; 2009.
- C. VSI (INST) - Vinyl Siding Installation Manual; Edition date unknown.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
- C. Color Charts: Where colors are not specified, provide samples of manufacturer's entire color line for selection.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. CertainTeed Corporation: www.certainteed.com/#sle.
- B. Substitutions: See Section 01 6000 - Product Requirements.

2.02 MATERIALS

- A. General Requirements:
 - 1. Siding: Complying with ASTM D3679.
- B. Horizontal Vinyl Siding:
 - 1. Profile: Clapboard, Double 4-Inch; 4 inches wide; 8 inch exposure.
 - 2. Thickness: 0.046 inch, minimum.
 - 3. Length: 16 feet, minimum.
 - 4. Nailing Hem: Single layer, with 1-1/8 inch long nail holes at maximum 18 inch on center.
 - 5. Finish: Smooth.
 - 6. Color: As selected by Architect from manufacturers full range of available colors.
- C. Shingles: Injection molded simulated cedar shingles made from thermoplastic polyolefin, complying with ASTM D3679 except for material composition.
 - 1. Profile: Perfection Style shingles; 60 by 10 double course panels.
 - 2. Profile: Half round shingles; 32 by 15 inches double course panels.
 - 3. Thickness: 0.10 inch, minimum.
 - 4. Nailing Hem: Single layer, with 1-1/8 inch long nail holes at maximum 18 inches on center.
 - 5. Color: Match siding.

2.03 ACCESSORIES

- A. Accessories: Provide coordinating accessories made of same material as required for complete and proper installation even when not specifically indicated on drawings.

1. **Mounting Block: Provide 6" x 6" or larger as required universal mounting block for all wall mounted items; (Lights, Knox Box, receptacles, hose bibbs etc.).**
 2. Color: Match adjacent siding or soffit panels.
- B. Fasteners: Aluminum nails, alloy 5056 or 6110, with minimum tensile strength of 63,000 pounds per square inch; length as required to penetrate framing at least 3/4 inch.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrate conditions before beginning installation; verify dimensions and acceptability of substrate.
- B. Do not proceed with installation until unacceptable conditions have been corrected.
- C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 INSTALLATION

- A. Install siding, soffit, and trim in accordance with manufacturer's printed installation instructions and VSI (INST).
- B. Attach securely to framing, not sheathing, with horizontal components true to level and vertical components true to plumb, providing a weather resistant installation.
- C. Any penetrations of the exterior air barrier system must be sealed per manufacturer's requirements.
- D. Clean dirt from surface of installed products, using mild soap and water.

3.03 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 07 4646
FIBER-CEMENT SIDING - ALTERNATE #ARC-1

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fiber-cement siding.

1.02 RELATED REQUIREMENTS

- A. Section 06 1000 - Rough Carpentry: Siding substrate.
- B. Section 07 2500 - Weather Barriers: Weather barrier under siding.
- C. Section 07 9200 - Joint Sealants: Sealing joints between siding and adjacent construction and fixtures.

1.03 REFERENCE STANDARDS

- A. ASTM C1186 - Standard Specification for Flat Fiber Cement Sheets; 2008 (Reapproved 2012).

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Submit manufacturer's data sheets on each product to be used, including:
 - 1. Manufacturer's requirements for related materials to be installed by others.
 - 2. Preparation instructions and recommendations.
 - 3. Storage and handling requirements and recommendations.
 - 4. Installation methods, including nail patterns.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Store products under waterproof cover and elevated above grade, on a flat surface.

PART 2 PRODUCTS

2.01 FIBER-CEMENT SIDING

- A. Lap Siding: Individual horizontal boards made of cement and cellulose fiber formed under high pressure with integral surface texture, complying with ASTM C1186, Type A, Grade II; with machined edges, for nail attachment.
 - 1. Style: Standard lap style.
 - 2. Texture: Smooth.
 - 3. Length: 12 ft, nominal.
 - 4. Width (Height): 6-1/4 inches. 4" Exposure
 - 5. Thickness: 5/16 inch, nominal.
 - 6. Finish: Factory applied topcoat.
 - 7. Color: As selected by Architect from manufacturers full range of available colors.
 - 8. Warranty: 50 year limited; transferable.
 - 9. Products:
 - a. CertainTeed Corporation : www.certainteed.com.
 - b. James Hardie Building Products, Inc: www.jameshardie.com/#sle.
- B. Shingle Panels: Panels giving appearance of multiple shingles made of cement and cellulose fiber formed under high pressure with integral surface texture, complying with ASTM C1186, Type A, Grade II; with machined edges, for nail attachment.
 - 1. Style 1: Random width, straight edge. (see drawings for locations)
 - 2. Style 2: Half Round (see drawings for locations)
 - 3. Texture: Smooth.
 - 4. Length: 48 inches.
 - 5. Width (Height): 7 inches. (5" Exposure)

6. Thickness: 1/4 inch, nominal.
7. Finish: Factory applied topcoat.
8. Warranty: 50 year limited; transferable.

2.02 ACCESSORIES

- A. **Mounting Block: Provide 6" x 6" or larger as required universal mounting block for all wall mounted items; (Lights, Knox Box, receptacles, hose bibbs etc.).**
- B. Trim: Same material and texture as siding.
- C. Fasteners: Galvanized or corrosion resistant; length as required to penetrate, 1-1/4 inch, minimum.
- D. Joint Sealer: As specified in Section 07 9005.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrate, clean and repair as required to eliminate conditions that would be detrimental to proper installation.
- B. Verify that weather barrier has been installed over substrate completely and correctly.
- C. Do not begin until unacceptable conditions have been corrected.
- D. If substrate preparation is responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions and recommendations.
 1. Read warranty and comply with terms necessary to maintain warranty coverage.
 2. Use trim details indicated on drawings.
 3. Touch up field cut edges before installing.
 4. Pre-drill nail holes if necessary to prevent breakage.
- B. Any penetrations of the exterior air barrier system must be sealed per manufacturer's requirements.
- C. Joints in Horizontal Siding: Avoid joints in lap siding except at corners; where joints are inevitable stagger joints between successive courses.
- D. Do not install siding less than 6 inches from surface of ground nor closer than 1 inch to roofs, patios, porches, and other surfaces where water may collect.
- E. After installation, seal joints except lap joints of lap siding; seal around penetrations, and paint exposed cut edges.
- F. Finish Painting: See Section 09 9113.

END OF SECTION

SECTION 07 5300
ELASTOMERIC MEMBRANE ROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Elastomeric roofing membrane, adhered conventional application.
- B. Insulation, flat.
- C. Cover boards.
- D. Flashings.
- E. Roofing cant strips, stack boots, roofing expansion joints, and walkway pads.

1.02 RELATED REQUIREMENTS

- A. Section 06 1000 - Rough Carpentry: Wood nailers and curbs.
- B. Section 07 6200 - SHEET METAL FLASHING AND TRIM: Counterflashings, reglets.

1.03 REFERENCE STANDARDS

- A. ASTM C208 - Standard Specification for Cellulosic Fiber Insulating Board; 2012.
- B. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2014.
- C. ASTM D4637/D4637M - Standard Specification for EPDM Sheet Used in Single-Ply Roof Membrane; 2013.
- D. FM (AG) - FM Approval Guide; current edition.
- E. FM DS 1-28 - Wind Design; 2007.
- F. NRCA (WM) - The NRCA Waterproofing Manual; 2005.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data indicating membrane materials, flashing materials.
- C. Shop Drawings: Indicate joint or termination detail conditions and conditions of interface with other materials.
- D. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manufacturer's original containers, dry and undamaged, with seals and labels intact.
- B. Store materials in weather protected environment, clear of ground and moisture.
- C. Ensure storage and staging of materials does not exceed static and dynamic load-bearing capacities of roof decking.
- D. Protect foam insulation from direct exposure to sunlight.

1.07 FIELD CONDITIONS

- A. Do not apply roofing membrane during unsuitable weather.
- B. Do not apply roofing membrane when ambient temperature is below 40 degrees F or above 100 degrees F.

- C. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.
- D. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.
- E. Schedule applications so that no partially completed sections of roof are left exposed at end of workday.

1.08 WARRANTY

- A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.
- B. **Provide 20 year manufacturer's material and labor warranty to cover failure to prevent penetration of water.**

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. EPDM Membrane Materials:
 - 1. Carlisle Roofing Systems, Inc; Sure-Seal EPDM: www.carlisle-syntec.com/#sle.
 - 2. Firestone Building Products, LLC: www.firestonebpc.com.
 - 3. GenFlex Roofing Systems, LLC: www.genflex.com.
 - 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Insulation:
 - 1. Dow Chemical Company: www.dow.com.
 - 2. GAF: www.gaf.com/#sle.
 - 3. Versico Roofing Systems: www.versico.com/#sle.
 - 4. Substitutions: See Section 01 6000 - Product Requirements.

2.02 ROOFING

- A. Elastomeric Membrane Roofing: One ply membrane, fully adhered, over insulation.
- B. Roofing Assembly Requirements:
 - 1. Factory Mutual Classification: Class 1 and windstorm resistance of 1-90, in accordance with FM DS 1-28.
- C. Acceptable Insulation Types - Constant Thickness Application: Any of the types specified.
 - 1. Minimum 2 layers of polyisocyanurate board.

2.03 ROOFING MEMBRANE AND ASSOCIATED MATERIALS

- A. Membrane: Ethylene-propylene-diene-monomer (EPDM); non-reinforced; complying with minimum properties of ASTM D4637/D4637M.
 - 1. Thickness: 0.060 inch (60 mil).
 - 2. Color: Gray.
- B. Seaming Materials: As recommended by membrane manufacturer.
- C. Flexible Flashing Material: Same material as membrane.

2.04 COVER BOARDS

- A. Cover Boards: Coated cellulosic fiberboard complying with ASTM C208.

2.05 INSULATION

- A. Polyisocyanurate (ISO) Board Insulation: Rigid cellular foam, complying with ASTM C1289.
 - 1. Classifications:
 - a. Type II:
 - 1) Class 1 - Faced with glass fiber reinforced cellulosic felt facers on both major surfaces of core foam.
 - 2) Compressive Strength: Classes 1-2-3, Grade 1 - 16 psi (110 kPa), minimum.
 - 3) Thermal Resistance, R-value: At 1-1/2 inches thick; Class 1, Grades 1-2-3 - 8.4 (1.48) at 75 degrees F.

2. Board Size: 48 by 96 inches.
3. Board Thickness: 2 Layers of 2.0 inch. R-22
4. Products:
 - a. Dow Chemical Company: www.dow.com/#sle.
 - b. GAF; EnergyGuard Polyiso Insulation: www.gaf.com/#sle.
 - c. Versico Roofing Systems; SecurShield Insulation: www.versico.com/#sle.
 - d. Substitutions: See Section 01 6000 - Product Requirements.

2.06 ACCESSORIES

- A. Stack Boots: Prefabricated flexible boot and collar for pipe stacks through membrane; same material as membrane.
- B. **Thermally Broken Equipment Support Blocks**
 1. Minimum R-10 thermal break
 2. Manufacturer: General Plastics Manufacturing Company.
 3. Product: LAST-A-FOAM® R-9300 Continuous Insulation Block.
- C. Cant and Edge Strips: Wood fiberboard, compatible with roofing materials; cants formed to 45 degree angle.
- D. Insulation Fasteners: Appropriate for purpose intended.
- E. Membrane Adhesive: As recommended by membrane manufacturer.
- F. Insulation Adhesive: As recommended by insulation manufacturer.
- G. Walkway Pads: Suitable for maintenance traffic, contrasting color or otherwise visually distinctive from roof membrane.
 1. Composition: Roofing membrane manufacturer's standard.
 2. Size: 18 by 18 inch.
 3. Surface Color: Gray

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces and site conditions are ready to receive work.
- B. Verify deck is supported and secure.
- C. Verify deck is clean and smooth, flat, free of depressions, waves, or projections, properly sloped and suitable for installation of roof system.
- D. Verify deck surfaces are dry and free of snow or ice.
- E. Verify that roof openings, curbs, and penetrations through roof are solidly set, and cant strips are in place.

3.02 PREPARATION - WOOD DECK

- A. Verify flatness and tightness of joints of wood decking.

3.03 INSULATION - UNDER MEMBRANE

- A. Attachment of Insulation:
 1. Mechanically fasten first layer of insulation to deck in accordance with roofing manufacturer's instructions.
 2. Embed second layer of insulation into full bed of adhesive in accordance with roofing and insulation manufacturers' instructions.
- B. Cover Boards: Mechanically fasten cover boards in accordance with roofing manufacturer's instructions and FM (AG) Factory Mutual requirements.
- C. Lay subsequent layers of insulation with joints staggered minimum 6 inches from joints of preceding layer.

- D. Lay boards with edges in moderate contact without forcing. Cut insulation to fit neatly to perimeter blocking and around penetrations through roof.
- E. Do not apply more insulation than can be covered with membrane in same day.

3.04 INSTALLATION - MEMBRANE

- A. Install elastomeric membrane roofing system in accordance with manufacturer's recommendations and NRCA (WM) applicable requirements.
- B. Roll out membrane, free from wrinkles or tears. Place sheet into place without stretching.
- C. Shingle joints on sloped substrate in direction of drainage.
- D. Fully Adhered Application: Apply adhesive to substrate at rate recommended by manufacturer. Fully embed membrane in adhesive except in areas directly over or within 3 inches of expansion joints. Fully adhere one roll before proceeding to adjacent rolls.
- E. Overlap edges and ends and seal seams by contact adhesive, minimum 3 inches. Seal permanently waterproof. Apply uniform bead of sealant to joint edge.
- F. Around roof penetrations, seal flanges and flashings with flexible flashing.

3.05 CLEANING

- A. Remove bituminous markings from finished surfaces.
- B. In areas where finished surfaces are soiled by work of this section, consult manufacturer of surfaces for cleaning advice and comply with their documented instructions.
- C. Repair or replace defaced or damaged finishes caused by work of this section.

3.06 PROTECTION

- A. Protect installed roofing and flashings from construction operations.
- B. Where traffic must continue over finished roof membrane, protect surfaces using durable materials.

END OF SECTION

**SECTION 07 7100
ROOF SPECIALTIES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Manufactured roof specialties, including copings. EPDM roof areas only.

1.02 REFERENCE STANDARDS

- A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels; 2013.
- B. ANSI/SPRI/FM 4435/ES-1 - Test Standard for Edge Systems Used with Low Slope Roofing Systems; 2017.
- C. NRCA (RM) - The NRCA Roofing Manual; 2017.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on shape of components, materials and finishes, anchor types and locations.
- C. Samples: Submit One appropriately sized samples of coping and gravel stop.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Roof Edge Flashings and Copings:
 - 1. ATAS International, Inc; Drip Edge Fascia: www.atas.com/#sle.

2.02 COMPONENTS

- A. Roof Edge Flashings: Factory fabricated to sizes required; corners mitered; concealed fasteners.
 - 1. Configuration: Fascia, cant, and edge securement for roof membrane.
 - 2. Pull-Off Resistance: Tested in accordance with ANSI/SPRI/FM 4435/ES-1 using test methods RE-1 and RE-2 to positive and negative design wind pressure as defined by applicable local building code.
 - 3. Material: Formed aluminum sheet, 0.050 inch thick, minimum.
 - 4. Finish: 70 percent polyvinylidene fluoride.
 - 5. Color: To be selected by Architect from manufacturer's standard range.
- B. Pipe and Penetration Flashing: Base of rounded aluminum, compatible with sheet metal roof systems, and capable of accomodating pipes sized between 3/8 inch and 12 inch.
 - 1. Caps: EPDM.
 - 2. Color: As indicated on drawings.

2.03 FINISHES

- A. PVDF (Polyvinylidene Fluoride) Coating: Superior Performance Organic Finish, AAMA 2605; multiple coat, thermally cured fluoropolymer finish system; color as indicated.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that deck, curbs, roof membrane, base flashing, and other items affecting work of this Section are in place and positioned correctly.

3.02 INSTALLATION

- A. Install components in accordance with manufacturer's instructions and NRCA (RM) applicable requirements.

- B. **Any metal flashing that is intended to be installed in a manner that penetrates an insulation layer must be reviewed and approved by the Owner's Passive House Consultant.**
- C. Seal joints within components when required by component manufacturer.
- D. Anchor components securely.
- E. Coordinate installation of components of this section with installation of roofing membrane and base flashings.
- F. Coordinate installation of sealants and roofing cement with work of this section to ensure water tightness.

END OF SECTION

**SECTION 07 7123
MANUFACTURED GUTTERS AND DOWNSPOUTS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Pre-finished aluminum gutters and downspouts.

1.02 REFERENCE STANDARDS

- A. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
- B. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric]; 2014.

1.03 DELIVERY, STORAGE, AND HANDLING

- A. Stack material to prevent twisting, bending, or abrasion, and to provide ventilation. Slope to drain.
- B. Prevent contact with materials that could cause discoloration, staining, or damage.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Pre-Finished Aluminum Sheet: ASTM B209 (ASTM B209M); 0.032 inch thick.
 - 1. Finish: Plain, shop pre-coated with modified silicone coating.
 - 2. Color: To match Corner Trim.

2.02 COMPONENTS

- A. Gutters: "K" Style rectangular style profile.
- B. Downspouts: CDA Rectangular profile.
- C. Anchors and Supports: Profiled to suit gutters and downspouts.
 - 1. Gutter Supports: Brackets.
 - 2. Downspout Supports: Straps.
 - a. Straps to be aluminum pipeclip brackets in size to match downspout by guttersupply.com
- D. Fasteners: Same material and finish as gutters and downspouts, with soft neoprene washers.

2.03 ACCESSORIES

- A. Downspout Boots: Plastic.

2.04 FABRICATION

- A. Form gutters and downspouts of profiles and size indicated.
- B. Fabricate with required connection pieces.
- C. Form sections square, true, and accurate in size, in maximum possible lengths, free of distortion or defects detrimental to appearance or performance. Allow for expansion at joints.
- D. Hem exposed edges of metal.
- E. Fabricate gutter and downspout accessories; seal watertight.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.

3.02 INSTALLATION

- A. Install gutters, downspouts, and accessories in accordance with manufacturer's instructions.

- B. **Any downspouts that require structural attachments to the backup wall and thus penetrate an insulation layer must be thermally broken.**
- C. Connect downspouts to underground infiltration system system. Seal connection watertight.

END OF SECTION

SECTION 07 7200
ROOF ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Equipment rails.
- B. Roof hatches.

1.02 REFERENCE STANDARDS

- A. 29 CFR 1910.23 - Guarding floor and wall openings and holes; current edition.
- B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.
- C. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.
- D. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.
- E. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric]; 2013.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used.
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
 - 4. Maintenance requirements.
- C. Warranty Documentation:
 - 1. Submit manufacturer warranty.
 - 2. Ensure that forms have been completed in Owner's name and registered with manufacturer.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store products under cover and elevated above grade.

1.05 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 ROOF HATCHES AND VENTS

- A. Sound Rated Roof Hatch Manufacturers:
- B. Roof Hatch Manufacturers:
 - 1. BILCO Company; Type S - Ladder Access: www.bilco.com/#sle.
 - 2. Substitutions: See Section 01 6000 - Product Requirements.
- C. Metal Covers: Flush, insulated, hollow metal construction.
 - 1. Capable of supporting 40 psf live load.
 - 2. Material: Galvanized steel; outer cover 14 gauge, 0.0747 inch thick, liner 22 gauge, 0.03 inch thick.

3. Finish: Factory prime paint.
 4. Insulation: Manufacturer's standard 1 inch rigid glass fiber.
 5. Gasket: Neoprene, continuous around cover perimeter.
- D. Safety Railing System: Roof hatch manufacturer's standard accessory safety rail system mounted directly to curb.
1. Railing: Comply with 29 CFR 1910.23 for ladder safety, with a safety factor of two.
 2. Posts and Rails: Galvanized steel tubing.
 3. Gate: Same material as railing; automatic closing with latch.
 4. Finish: Manufacturer's standard, factory applied finish.
 5. Gate Hinges and Post Guides: ASTM B221 (ASTM B221M), 6063 alloy, T5 temper aluminum.
 6. Mounting Brackets: Hot dipped galvanized steel, 1/4 inch thick, minimum.
 7. Fasteners: Stainless steel, Type 316.
 8. Manufacturers:
 - a. BILCO Company; Bil-Guard 2.0: www.bilco.com/#sle.
- E. Hardware: Steel, zinc coated and chromate sealed, unless otherwise indicated or required by manufacturer.
1. Lifting Mechanisms: Compression or torsion spring operator with shock absorbers that automatically opens upon release of latch; capable of lifting covers despite 10 psf load.
 2. Hinges: Heavy duty pintle type.
 3. Hold open arm with vinyl-coated handle for manual release.
 4. Latch: Upon closing, engage latch automatically and reset manual release.
 5. Manual Release: Pull handle on interior.
 6. Locking: Padlock hasp on interior.

2.02 NON-PENETRATING ROOFTOP SUPPORTS/ASSEMBLIES

- A. Non-Penetrating Rooftop Support/Assemblies: Manufacturer-engineered and factory-fabricated, with pedestal bases that rest on top of roofing membrane, and not requiring any attachment to roof structure and not penetrating roofing assembly.
1. Design Loadings and Configurations: As required by applicable codes.
 2. Support Spacing and Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
 3. Steel Components: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.
 4. Hardware, Bolts, Nuts, and Washers: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A153/A153M.
- B. Non-Penetrating Safety Rail System: Manufactured engineered, ballasted edge protection safety rail system
1. Must meet OSHA fall protection standard 29CFR 1910.23 and 29 CFR 1926.502.
 2. Install in locations and lengths indicated on the drawings.
 3. Provide gates where required.
 4. Manufacturer: Edge Fall Protection, LLC, SRC 360 Mobile Safety Rail System
 - a. Substitutions: See Section 01 6000- Product Requirements

PART 3 EXECUTION

3.01 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

- A. Clean surfaces thoroughly prior to installation.

- B. Prepare surfaces using methods recommended by manufacturer for achieving acceptable results for applicable substrate under project conditions.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions, in manner that maintains roofing system weather-tight integrity.

3.04 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

**SECTION 07 8400
FIRESTOPPING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Firestopping systems.
- B. Firestopping of joints and penetrations in fire-resistance-rated and smoke-resistant assemblies, whether indicated on drawings or not, and other openings indicated.

1.02 RELATED REQUIREMENTS

- A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

1.03 REFERENCE STANDARDS

- A. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2015.
- B. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Fire Stops; 2013a.
- C. ITS (DIR) - Directory of Listed Products; current edition.
- D. FM (AG) - FM Approval Guide; current edition.
- E. SCAQMD 1168 - South Coast Air Quality Management District Rule No.1168; current edition.
- F. UL 1479 - Standard for Fire Tests of Penetration Firestops; Current Edition, Including All Revisions.
- G. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.
- H. UL (FRD) - Fire Resistance Directory; current edition.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on product characteristics, performance ratings, and limitations.
- C. Sustainable Design Submittal: Submit VOC content documentation for nonperformed materials.
- D. Manufacturer's qualification statement.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.06 FIELD CONDITIONS

- A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation; maintain minimum temperature before, during, and for three days after installation of materials.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Firestopping Materials: Any materials meeting requirements.
- B. Volatile Organic Compound (VOC) Content: Provide products having VOC content lower than that required by SCAQMD 1168.
- C. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Provide type of materials as required for tested firestopping assembly.

2.02 FIRESTOPPING ASSEMBLY REQUIREMENTS

- A. Through Penetration Firestopping: Use system that has been tested according to ASTM E814 to have fire resistance F Rating equal to required fire rating of penetrated assembly.

1. Listing by FM (AG), ITS (DIR), UL (DIR), or UL (FRD) in their certification directories will be considered evidence of successful testing.

2.03 FIRESTOPPING PENETRATIONS THROUGH GYPSUM BOARD WALLS

- A. Penetrations By:
 1. Uninsulated Metallic Pipe, Conduit, and Tubing:
 - a. 1 Hour Construction: UL System W-L-1054; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 2. Uninsulated Non-Metallic Pipe, Conduit, and Tubing:
 - a. 1 Hour Construction: UL System W-L-2128; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 3. Electrical Cables Not In Conduit:
 4. Insulated Pipes:

2.04 FIRESTOPPING SYSTEMS

- A. Firestopping: Any material meeting requirements.
 1. Fire Ratings: Use system that is listed by FM (AG), ITS (DIR), or UL (FRD) and tested in accordance with ASTM E814, ASTM E119, or UL 1479 with F Rating equal to fire rating of penetrated assembly and minimum T Rating Equal to F Rating and in compliance with other specified requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify openings are ready to receive the work of this section.

3.02 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other materials that could adversely affect bond of firestopping material.
- B. Remove incompatible materials that could adversely affect bond.

3.03 INSTALLATION

- A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.

3.04 CLEANING

- A. Clean adjacent surfaces of firestopping materials.

3.05 PROTECTION

- A. Protect adjacent surfaces from damage by material installation.

END OF SECTION

**SECTION 07 9200
JOINT SEALANTS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Nonsag gunnable joint sealants.
- B. Joint backings and accessories.

1.02 REFERENCE STANDARDS

- A. ASTM C661 - Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer; 2006 (Reapproved 2011).
- B. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2014.
- C. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2013.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data for Sealants: Submit manufacturer's technical data sheets for each product to be used, that includes the following.
 - 1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
 - 2. List of backing materials approved for use with the specific product.
 - 3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
 - 4. Substrates the product should not be used on.
- C. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.

1.04 QUALITY ASSURANCE

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

1.05 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective work within a five year period after Date of Substantial Completion.
- C. Warranty: Include coverage for installed sealants and accessories that fail to achieve watertight seal, exhibit loss of adhesion or cohesion, or do not cure.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Non-Sag Sealants: Permits application in joints on vertical surfaces without sagging or slumping.
 - 1. Dow Chemical Company:
consumer.dow.com/en-us/industry/ind-building-construction.html/#sle.
 - 2. Pecora Corporation: www.pecora.com.
 - 3. Sherwin-Williams Company: www.sherwin-williams.com/#sle.
 - 4. Sika Corporation: www.usa-sika.com/#sle.
 - 5. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com/#sle.
 - 6. Substitutions: See Section 01 6000 - Product Requirements.

2.02 JOINT SEALANT APPLICATIONS

- A. Scope:

1. Exterior Joints: Seal open joints, whether or not the joint is indicated on drawings, unless specifically indicated not to be sealed. Exterior joints to be sealed include, but are not limited to, the following items.
 - a. Wall expansion and control joints.
 - b. Joints between door, window, and other frames and adjacent construction.
 - c. Joints between different exposed materials.
 - d. Openings below ledge angles in masonry.
 - e. Other joints indicated below.
 2. Interior Joints: Do not seal interior joints unless specifically indicated to be sealed. Interior joints to be sealed include, but are not limited to, the following items.
 - a. Joints between door, window, and other frames and adjacent construction.
 - b. Other joints indicated below.
 3. Do not seal the following types of joints.
 - a. Intentional weepholes in masonry.
 - b. Joints indicated to be treated with manufactured expansion joint cover or some other type of sealing device.
 - c. Joints where sealant is specified to be provided by manufacturer of product to be sealed.
 - d. Joints where installation of sealant is specified in another section.
 - e. Joints between suspended panel ceilings/grid and walls.
- B. Exterior Joints: Use non-sag silyl-terminated polyether/polyurethane sealant, unless otherwise indicated.
- C. Interior Joints: Use non-sag polyurethane sealant, unless otherwise indicated.
 1. Joints between Fixtures in Wet Areas and Floors, Walls, and Ceilings: Mildew-resistant silicone sealant; white.
 2. In Sound-Rated Assemblies: Acrylic emulsion latex sealant.
- D. Interior Wet Areas: Bathrooms and restrooms; fixtures in wet areas include plumbing fixtures, countertops, and other similar items. **Use Mildew-Resistant Silicone Sealant.**
- E. Sound-Rated Assemblies: Walls and ceilings identified as "STC-rated", "sound-rated", or "acoustical".

2.03 JOINT SEALANTS - GENERAL

2.04 NONSAG JOINT SEALANTS

- A. Mildew-Resistant Silicone Sealant: ASTM C920, Grade NS, Uses M and A; single component, mildew resistant; not expected to withstand continuous water immersion or traffic.
 1. Color: White.
- B. Hybrid UrethanePolyether (STPE) and Polyurethane (STPU) Sealant: ASTM C920, Grade NS, Uses M and A; single component; not expected to withstand continuous water immersion or traffic.
 1. Movement Capability: Plus and minus 35 percent, minimum.
 2. Color: To be selected by Architect from manufacturer's standard range.
 3. Manufacturers:
 - a. Franklin International Inc; Titebond WeatherMaster ULTIMATE MP Sealant: www.titebond.com/#sle.
 - b. Sherwin-Williams Company; Stampede 100 Low-Modulus Hybrid Urethane Sealant: www.sherwin-williams.com/#sle.
 - c. Tremco Commercial Sealants and Waterproofing; Dymonic FC: www.tremcosealants.com/#sle.
 - d. Substitutions: See Section 01 6000 - Product Requirements.
- C. Polyurethane Sealant: ASTM C920, Grade NS, Uses M and A; single or multi-component; not expected to withstand continuous water immersion or traffic.
 1. Movement Capability: Plus and minus 25 percent, minimum.

2. Hardness Range: 20 to 35, Shore A, when tested in accordance with ASTM C661.
3. Color: To be selected by Architect from manufacturer's standard range.
4. Manufacturers:
 - a. Sherwin-Williams Company; Stampede-1/-TX Polyurethane Sealant:
www.sherwin-williams.com/#sle.
 - b. Sika Corporation; Sikaflex-1a: www.usa-sika.com/#sle.
 - c. Tremco Commercial Sealants & Waterproofing; Dymeric 240 FC:
www.tremcosealants.com/#sle.
 - d. Substitutions: See Section 01 6000 - Product Requirements.

2.05 ACCESSORIES

- A. Backer Rod: Cylindrical cellular foam rod with surface that sealant will not adhere to, compatible with specific sealant used, and recommended by backing and sealant manufacturers for specific application.
 1. Open Cell: 40 to 50 percent larger in diameter than joint width.
- B. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.
- C. Primers: Type recommended by sealant manufacturer to suit application; non-staining.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that joints are ready to receive work.
- B. Verify that backing materials are compatible with sealants.
- C. Verify that backer rods are of the correct size.

3.02 PREPARATION

- A. Remove loose materials and foreign matter that could impair adhesion of sealant.
- B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.
- C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.
- D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.

3.03 INSTALLATION

- A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B. Perform installation in accordance with ASTM C1193.
- C. Install bond breaker backing tape where backer rod cannot be used.
- D. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.
- E. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.
- F. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

END OF SECTION

SECTION 08 1113
HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Non-fire-rated hollow metal doors and frames.
- B. Hollow metal frames for wood doors.
- C. Fire-rated hollow metal doors and frames.
- D. Thermally insulated hollow metal doors with frames.
- E. Hollow metal borrowed lites glazing frames.
- F. Accessories, including glazing and matching panels.

1.02 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors; 2011.
- C. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2014.
- D. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2011.
- E. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- F. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable; 2015.
- G. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2014.
- H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- I. ASTM C1363-05 - Standard Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus.
- J. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2009.
- K. ITS (DIR) - Directory of Listed Products; current edition.
- L. NAAMM HMMA 840 - Guide Specifications for Installation and Storage of Hollow Metal Doors and Frames; 2007.
- M. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2016.
- N. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2012.
- O. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.
- P. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced standards/guidelines.

- C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
- B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Hollow Metal Doors and Frames:
 - 1. Ceco Door, an Assa Abloy Group company: www.assaabloydss.com.
 - 2. Curries, an Assa Abloy Group company: www.assaabloydss.com.
 - 3. Republic Doors, an Allegion brand: www.republicdoor.com/#sle.
 - 4. Steelcraft, an Allegion brand: www.allegion.com/#sle.
 - 5. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PERFORMANCE REQUIREMENTS

- A. Requirements for Hollow Metal Doors and Frames:
 - 1. Steel Sheet: Comply with one or more of the following requirements; galvanized steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.
 - 2. Accessibility: Comply with ICC A117.1 and ADA Standards.
 - 3. Exterior Door Top Closures: Flush end closure channel, with top and door faces aligned.
 - 4. Door Edge Profile: Manufacturers standard for application indicated.
 - 5. Typical Door Face Sheets: Flush.
 - 6. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings. Style: Manufacturers standard.
- B. Hollow Metal Panels: Same construction, performance, and finish as doors.
- C. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.03 HOLLOW METAL DOORS

- A. Door Finish: Factory primed and field finished.
- B. Exterior Doors: Thermally insulated.
 - 1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
 - a. Level 3 - Extra Heavy-duty.
 - b. Physical Performance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.
 - c. Model 3 - Stile and Rail.
 - d. Door Face Metal Thickness: 18 gauge, 0.042 inch, minimum.
 - e. Zinc Coating: A60/ZF180 galvanized coating; ASTM A653/A653M.

2. Door Core Material: Polystyrene, 1 lbs/cu ft minimum density.
 - a. Foam Plastic Insulation: Manufacturer's standard board insulation with maximum flame spread index (FSI) of 75, and maximum smoke developed index (SDI) of 450 in accordance with ASTM E84, and completely enclosed within interior of door.
 3. Door Thermal Resistance: R-Value of 6.0 minimum, for installed thickness of polystyrene. Calculated in accordance with ASTM C1363-05
 4. Door Thickness: 1-3/4 inches, nominal.
- C. Interior Doors, Non-Fire Rated:
1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
 - a. Level 1 - Standard-duty.
 - b. Physical Performance Level C, 250,000 cycles; in accordance with ANSI/SDI A250.4.
 - c. Model 1 - Full Flush.
 - d. Door Face Metal Thickness: 20 gauge, 0.032 inch, minimum.
 2. Door Core Material: Manufacturers standard core material/construction and in compliance with requirements.
 3. Door Thickness: 1-3/4 inches, nominal.
- D. Fire-Rated Doors:
1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
 - a. Level 3 - Extra Heavy-duty.
 - b. Physical Performance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.
 - c. Model 3 - Stile and Rail.
 - d. Door Face Metal Thickness: 16 gauge, 0.053 inch, minimum.
 2. Fire Rating: As indicated on Door Schedule, tested in accordance with UL 10C and NFPA 252 ("positive pressure fire tests").
 3. Provide units listed and labeled by UL (DIR) or ITS (DIR).
 - a. Attach fire rating label to each fire rated unit.
 4. Door Thickness: 1-3/4 inches, nominal.

2.04 HOLLOW METAL FRAMES

- A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.
- B. Exterior Door Frames: Knock-down type.
 1. **Provide Thermally broken frame.**
 2. Galvanizing: Components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with A40/ZF120 coating.
 3. Frame Metal Thickness: 18 gauge, 0.042 inch, minimum.
 4. Frame Finish: Factory primed and field finished.
 5. Weatherstripping: Separate, see Section 08 7100.
- C. Interior Door Frames, Non-Fire Rated: Knock-down type.
 1. Terminated Stops: Provide at interior doors; closed end stop terminated 6 inch, maximum, above floor at 45 degree angle.
 2. Frame Metal Thickness: 18 gauge, 0.042 inch, minimum.
 3. Frame Finish: Factory primed and field finished.
- D. Door Frames, Fire-Rated: Knock-down type.
 1. Fire Rating: Same as door, labeled.
- E. Frames for Wood Doors: Comply with frame requirements in accordance with corresponding door.
- F. Borrowed Lites Glazing Frames: Construction and face dimensions to match door frames, and as indicated on drawings.

2.05 FINISHES

- A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

2.06 ACCESSORIES

- A. Glazing: As specified in Section 08 8000, factory installed.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Verify that finished walls are in plane to ensure proper door alignment.

3.02 INSTALLATION

- A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.
- B. Install fire rated units in accordance with NFPA 80.
- C. Coordinate frame anchor placement with wall construction.
- D. Install door hardware as specified in Section 08 7100.
- E. Touch up damaged factory finishes.

3.03 ADJUSTING

- A. Adjust for smooth and balanced door movement.

END OF SECTION

**SECTION 08 1433
MOULDED WOOD DOORS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Moulded Wood Fiber Doors (Solid Core)

1.02 RELATED REQUIREMENTS

- A. Section 06 2000 - Finish Carpentry: Wood door frames.
- B. Section 08 7100 - DOOR HARDWARE.
- C. Section 09 9000 - Painting and Coating
- D. Section 09 9123 - Interior Painting: Field finishing.

1.03 REFERENCE STANDARDS

- A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014.
- B. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.0; 2016.
- C. ITS (DIR) - Directory of Listed Products; current edition.
- D. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2016.
- E. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2012.
- F. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.
- G. UL 10B - Standard for Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Indicate stile and rail core materials and construction; veneer species, type and characteristics.
- C. Manufacturer's Qualification Statement.
- D. Warranty, executed in Owner's name.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section, with not less than three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Package, deliver, and store doors in accordance with quality standard specified.
- B. Accept doors on site in manufacturer's packaging, and inspect for damage.
- C. Protect doors with resilient packaging sealed with heat shrunk plastic; do not store in damp or wet areas or areas where sunlight might bleach veneer; seal top and bottom edges with tinted sealer if stored more than one week, and break seal on site to permit ventilation.

1.07 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Interior Doors: Provide manufacturer's warranty for five years.
- C. Include coverage for warping beyond specified installation tolerances and defective materials.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Moulded Wood Doors:

1. Masonite Corporation 4 Panel Moulded Door.
2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 DOORS

- A. Quality Standard: Custom Grade, Heavy Duty performance, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless otherwise indicated.
- B. Interior Doors: 1-3/8 inches thick unless otherwise indicated; solid lumber construction; Factory Primed

2.03 DOOR AND PANEL FACINGS

- A. Materials for Opaque Finishes: Hardboard faces.
- B. Adhesive: Type I - Waterproof.

2.04 COMPONENTS

- A. **Peep Holes: Shall be provided at unit doors. Accessible units shall be provided with two peepholes - standard height and accessible height as determined by ADA standards**
 1. Glazed Openings:
 - a. Film: Applied film for translucent finish.

2.05 DOOR CONSTRUCTION

- A. Vertical Exposed Edge of Stiles: Of same species as veneer facing.
- B. Bond edge banding to cores.
- C. Fire Rated Doors: Tested to 20 minutes in accordance with NFPA 252 or UL 10B - Negative (Neutral) Pressure; listed in UL (DIR) or ITS (DIR) and without any visible seals when door is open.

2.06 ACCESSORIES

- A. Wood Door Frames: Manufacturer's standard pre-hung.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Do not install doors in frame openings that are not plumb or are out of tolerance for size or alignment.

3.02 INSTALLATION

- A. Install doors in accordance with manufacturer's instructions and specified quality standards.
 1. Install fire-rated doors in accordance with NFPA 80 requirements.
- B. Adjust width of non-rated doors by cutting equally on both jamb edges.
- C. Trim door height by cutting bottom edges to a maximum of 3/4 inch.
- D. Machine cut for hardware.
- E. Coordinate installation of doors with installation of frames and hardware.

3.03 TOLERANCES

- A. Comply with specified quality standard for fit, clearance, and joinery tolerances.

3.04 ADJUSTING

- A. Adjust doors for smooth and balanced door movement.
- B. Adjust closers for full closure.

3.05 SCHEDULE - SEE DRAWINGS

END OF SECTION

SECTION 08 1520
VINYL DOORS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Alpen Tyrol Series comprised of REHAU System 4700 fully welded glass-fiber reinforced vinyl (PVC) prime doors as listed below. All doors are factory assembled, and include all required glass and glazing materials; any internal structural metal reinforcement (stiffeners) that may be required (e.g. to meet design loads, mulling conditions, reinforcement of non-white vinyl and/or proper operation); door hardware, weatherstripping and, if specified, insect screens.
 - 1. Size and Quantity of each type of vinyl doors as shown on drawings
 - 2. Configurations of doors required:
 - a. Prime side hinged door with fixed adjacent leaf.
- B. Related Sections:
 - 1. Section 07 92 00 Joint Sealants
 - 2. Section 08 15 20 Hinged Vinyl-Framed Glass Doors
 - 3. Section 08 15 70 Sliding Vinyl-Framed Glass Doors
 - 4. Section 08 80 00 Glass

1.02 REFERENCES

- A. Publications listed below are part of this specification to the extent they are referenced. When publications are cited in these specifications by use of shortened names or by standard number alone, it must be understood that reference is made to the full publication and edition as listed here.
- B. American Architectural Manufacturers Association (AAMA):
 - 1. AAMA/WDMA/CSA 101/I.S.2/A440-11, NAFS 2011 North American Fenestration Standard/Specification for windows, doors and skylights
 - 2. AAMA 303 -08, Voluntary Specification for Rigid Polyvinyl Chloride (PVC) Exterior Profiles
 - 3. AAMA 310 - 12, Voluntary Specifications for Reinforced Thermoplastic Fenestration Exterior Profile Extrusions
 - 4. AAMA 502 -11 Voluntary Specification for Field Testing of Windows and Sliding Glass Doors
 - 5. AAMA 800 – 10 Voluntary Specifications and Test Methods for Sealants
- C. American Society of Civil Engineers:
 - 1. ASCE 7 – 10 Minimum Design Loads for Buildings and Other Structures, ASCE/SEI 2005
- D. American Society for Testing and Materials
 - 1. ASTM E 90 -09 Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
 - 2. ASTM E 1332 – 10a, Standard Classification for Determination of Outdoor-Indoor Sound Attenuation
 - 3. German Institute for Standardization (Deutsches Institut für Normung)
 - a. DIN 18357 German construction contract procedures - Part C: General technical specifications for building works - Mounting of window and door fittings
 - b. DIN EN 10327, Continuously hot-dip coated strip or sheet of low-carbon steels for cold forming, Technical delivery conditions
 - 4. Glass Association of North America:
 - a. GANA Glazing Manual (2004)
 - 5. National Fenestration Rating Council, Inc.
 - a. NFRC 100 – 2014, Procedure for Determining Fenestration Product U-Factors

- b. NFRC 200 – 2014, Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence
 - c. NFRC 500 – 2014, Procedure for Determining Fenestration Product Condensation Resistance Values
 - d. NFRC 102 – 2014 Procedure for Measuring the Steady-State Thermal Transmittance of Fenestration Systems
6. REHAU Incorporated
- a. System 4700 Technical Information, Profile Print
 - b. System 4700 Technical Information, Size Limitations
 - c. System 4700 Technical Information, Glazing Instructions
 - d. System 4700 Technical Information, Reinforcement Guidelines

1.03 SYSTEM DESCRIPTION

- A. Structural Design Requirements:
- 1. Design Loads:
 - 2. Doors shall be identical in construction to test doors that comply with all requirements of: AAMA 101 Performance Class CW-PG 70-SHD 46" x 90" performance as determined by ASCE 7.
 - 3. Comply with all applicable Building Codes.
- B. Other Performance Requirements:
- 1. Allow for thermal movement of the window based on site mean temperature +/- 70 °F, door/element size and coefficient of linear expansion of PVC.
 - 2. If non-white doors are chosen allow for thermal movement of the door based on
 - a. the solar-heat absorption.
 - 1) Thermal Performance:
 - (a) Comply with all applicable energy codes and ENERGY STAR®
 - (b) The doors, including glass and vinyl framing, shall have a thermal transmittance (U-factor) of ≤ 0.50 Btu/hr* ft^2 *°F, when tested in compliance with NFRC 100-2014
 - (c) The doors, including glass and vinyl framing, shall have a Solar heat gain coefficient (SHGC) of 0.40 at Building A and 0.37 at Building B when tested in compliance with NFRC 200-2014

1.04 SUBMITTALS

- A. Product Data:
- 1. Manufacturer's printed literature describing specified products shall be submitted in accordance with Section 01 33 00.
 - 2. REHAU Incorporated printed literature describing quality of vinyl extrusions.
- B. Shop Drawings:
- 1. Submit dimensioned shop drawings for system. Show materials, anchorage, field connections, sealants and glazing.
 - 2. Drawings shall show scale elevations and sections. Full size sections shall be shown only when needed for clarity.
- C. Samples:
- 1. Selection Samples:
 - a. Submit color samples displaying manufacturer's standard colors and finishes for initial selection by Architect. Submit actual material samples of colors and finishes available.
 - b. Sample Size: Not less than 6" length of vinyl profile
 - 1) Samples submitted shall be of production type and shall represent quality of finish to be furnished by manufacturer. No work represented by samples shall be fabricated until samples are accepted.
- D. Quality Assurance Submittals:

1. Test Reports:
 - a. Submit certified test reports from an AAMA accredited, independent testing laboratory showing system has been tested and meets or exceeds specified requirements and indicating full compliance with specified performance criteria.

1.05 QUALITY ASSURANCE

- A. Qualifications:
 1. This portion of Work shall be provided by a single firm, who has specialized in the fabrication of fully welded vinyl doors and is trained in the application and adjustment of door hardware.
 2. The window/door fabricator shall be fully trained by a REHAU technical representative in the approved techniques and methods of fabricating System 4700 vinyl doors. Training or auditing shall have occurred within two years of the commencement of this project.
 3. The window/door fabricator shall be an authorized REHAU fabricator in good standing.
- B. Materials:
 1. Only REHAU Quality vinyl extrusions and REHAU approved components shall be used.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Packing, Shipping, Handling, and Unloading:
 1. A temporary covering shall protect exposed surfaces after completing fabrication of products.
 2. Deliver materials in manufacturer's original packaging with labels intact.
- B. Storage and Protection:
 1. Store doors/elements vertically, inside, in a clean and dry location.
 2. Stacking shall be done in a way to prevent bending.
 3. Cover stacks in a manner to provide air circulation and to reasonably protect materials from damage.
 4. Keep on-site handling to a minimum. Exercise particular care to avoid damage to finishes. Damaged or deteriorated materials shall be removed from the site.

1.07 PROJECT CONDITIONS

- A. Environmental Requirements:
 1. Do not proceed with jobsite sealant application when ambient and substrate temperature conditions are not within limits permitted by sealant manufacturer.
 2. Sealants shall not be applied when joint substrates are wet due to rain, frost, condensation or other causes.
- B. Field Measurements:
 1. Verify dimensions of surrounding construction by field measurements so work will be accurately fabricated, and fitted to structure. Contractor and manufacturer shall cooperate to establish and maintain these field dimensions. If the contractor guarantees the dimensions, no field measurements are needed.

1.08 SPECIAL WARRANTY

- A. Provide a written warranty signed by both the window/door fabricator and the installer agreeing to repair or replace defective materials or workmanship, including evidence of early deterioration, weathering or aging of Work, uncontrolled water penetration or air infiltration, glass breakage due to design defects, deterioration of finishes, failure of operating parts to properly function and other deterioration or failure of Work to comply with performance or other requirements. Warranty shall be for a period of 5 years from Date of Substantial Completion.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Vinyl (PVC) Windows/Doors :

1. REHAU Window Designs as provided by Alpen High Performance Products (HPP)
 - a. Alpen High Performance Products
 - b. 6268 Monarch Park Pl.
 - c. Niwot, CO 80504
2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 MATERIALS

- A. Window/Door System: Alpen Tyrol Series Vinyl Window/Door System.
 1. Doors on this project shall be furnished and installed in the sizes, configurations and quantities as described in the Project Contract Documents and within the allowed parameters in PART 1, Section 1 of this specification.
 2. All extruded vinyl shall be made from RAU PVC for supplementary profiles and RAU-FIPRO (weldable, glass fiber reinforced PVC) for main profiles such as frame sash and T-mullions
 3. Minimum Outside Nominal Wall Thickness:
 - a. Primary frame and sash extrusions' exterior walls: 0.106" (2.7 mm)
 - b. Secondary extrusions (e.g. glazing stops and closures): 0.067" (1.8 mm)
 - 1) Face Dimensions (nominal): As indicated on Architectural Drawings
 - 2) Window frames shall be multiple chambers in the frame providing structural strength, thermal insulation and separation of drainage passages from any metal reinforcing profiles.
 - 3) Window sash and frame shall be configured to receive glazing beads (stops) that snap in on the interior side of the glass for dry glazing applications.
 - 4) Glazing beads (stops) shall incorporate coextruded black RAU-PREN glazing seals.
- B. Reinforcement:
 1. If required (see current Alpen Tyrol Series technical information), custom shaped steel reinforcements for the internal applications in windows and doors must be used.
 2. Galvanized steel specified according to EN 10327, Grade DX 51D+Z275-N-A-C
 3. Galvanized Steel shall be in size, configuration and location within the door as indicated in the test reports and REHAU System 4700, Reinforcement Instructions
 4. Reinforcement must be used in all main profiles (such as frame, sash or t-mullion), which are non-white
 5. Reinforcement must be used between doors, which are joined with each other and must be sufficiently sized and anchored according to the structural requirements.
- C. Weatherseals:
 1. Black co-extruded polymer replaceable weatherseals:
 - a. Shapes, designs, and thickness as needed to satisfy performance requirements.
 - b. Replacement weatherseals shall be provided in continuous lengths, butted firm to ends of races and to each other when in the same planes.
- D. Glass:
 1. Glass shall comply with requirements of AAMA/WDMA/CSA 101/I.S.2/A440-11, Section 10.2 and the GANA Glazing Manual.
 2. Glass to be Balance TR 6 6 PH Plus TGT

2.03 ACCESSORIES

- A. Fasteners: Stainless Steel: AISI 300 Series
 1. Fasteners shall be selected to prevent galvanic reaction with any reinforcement materials fastened.
 2. Above criteria is applicable to screws used to secure internal reinforcement and to fasteners used in window mulling connections, if required.
 3. Avoid exposed fasteners to greatest extent possible.
 4. Where exposed fasteners are unavoidable in finished surfaces, use flathead countersunk Phillips head screws.

5. Installation anchors must be approved by the responsible engineer/architect for the project
- B. Sealants:
1. Sealants shall comply with requirements of AAMA 800

2.04 FABRICATION

- A. General Requirements:
1. Follow all requirements of the REHAU fabrication guidelines
 2. Miter cut and fusion weld (i.e. thermally weld) all frame and sash corners.
 3. Complete fabrication, assembly, finishing, hardware application, and other work for each individual door unit before shipment to Site. Field assembly to connect two or more mulled doors and windows is permitted.
 4. Provide baffled drainage holes to drain moisture to exterior.
- B. Welding:
1. Welding shall be done in compliance with applicable recommendations and shall be done with materials and equipment as recommended by REHAU.
 2. Welds shall be finished and dressed.
- C. System:
1. Window construction, edge clearance and placement of installation fasteners shall allow for expansion and contraction per the specified system performance requirements.
 2. Provisions shall be made in framing, including sash, for minimum glass edge clearance, nominal edge cover, and nominal pocket width, in compliance with GANA Glazing Manual, for thickness and type glass specified.
 3. Framing shall be provided with reinforcing members as necessary. Provide steel members as needed to reinforce frame, T-mullion and/or sash components as recommended by REHAU to develop needed strength of assembly.
- D. Hardware
- E. Quality hardware is to be used for vinyl side hinged doors. Hardware shall meet the requirements according to the German Standard DIN 18357. Material used must be corrosion resistant. Ability for repair and maintenance must be given. The installation must be performed according to the guidelines given by the hardware manufacturer. The fastening of the hardware components has to be safe and secure, preferably into steel reinforcements or at least through 2 PVC walls, meeting the requirements for the actual loads of the sash. Fasteners have to be corrosion resistant.
- F. Insect Screens
1. 1. Insect screens shall conform to AAMA 101, section 11.6
 2. 2. Insect screens are mounted, if specified.

2.05 SHOP FINISHES

- A. Color: White
- B. Protection:
1. Provide film to protect exposed finished surfaces during shipment, storage, and installation whenever possible.
 2. Film shall not affect factory finish after finished component is installed and film is stripped, no residue, adhesive, or film covering, visual non-uniformity or other deleterious effects or substances shall remain on surfaces.
 3. Factory applied protective film must be removed immediately after installation.
 4. When cleaning agents/paint etc. are applied to the building the doors must be protected.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Site Verification of Conditions:

1. Examine door openings and adjacent building structure where doors will be applied for conditions that will prevent proper execution of this portion of Work and endanger permanency.
2. Do not proceed with installation until defects have been corrected.
3. Verify sealant compatibility and adhesion to vinyl in conjunction with sealant manufacturer.

3.02 PREPARATION

- A. Coordination:
1. Coordinate installation with work of other trades.

3.03 INSTALLATION

- A. General Requirements:
1. Comply with manufacturer's instructions and recommendations for installation of work. Follow the state-of-the-art Installation Masters™ guidelines.
 2. Do not erect warped, bowed, deformed or otherwise damaged or defaced members. Replace materials that are damaged during installation as directed.
 3. Set units level, plumb, and true to line, with uniform joints. Support units on shims and secure in place by approved installation anchors/fasteners that properly engage into supporting structure.
 4. Insulation must be used around the perimeter of the door in accordance with shop drawings and the insulation manufacturer's guidelines. Insulation must allow for expansion and contraction of the installed door.
 5. Flashing and other materials used around door opening shall be corrosion resistant, non-staining, non-bleeding, and compatible with adjoining materials.
- B. Erection Tolerances:
1. Variations from Plumb: $\pm 1/8$ " maximum in door height.
 2. Variations from Level: $\pm 1/8$ " maximum in 10' run, non-cumulative.

3.04 FIELD QUALITY CONTROL

- A. Field Check for Water Leakage:
1. After completion of installation and nominal curing of sealant and glazing compounds, but before installation of interior finishes, perform AAMA 502 test. Architect will determine the quantity and type(s) of door(s) to be tested.
 2. In case of water penetration take corrective action and re-test as necessary until the problem is resolved.

3.05 ADJUSTING

- A. Weatherseal contact shall be checked and any required final hardware adjustment made for proper operation and performance of units.

3.06 CLEANING

- A. Clean completed system in compliance with manufacturer's recommendations, inside and out, promptly after erection and installation of glass and sealants. Remove excess glazing and joint sealants, dirt, and other substances from finished surfaces promptly after erection.
- B. Remove protective material from prefinished surfaces.
- C. Wash down exposed surfaces using a solution of mild detergent in warm water applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.

3.07 PROTECTION

- A. Institute protective measures and other precautions needed to assure Work will be without damage or deterioration, other than normal weathering, at time of acceptance.

END OF SECTION

**SECTION 08 3100
ACCESS DOORS AND PANELS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Wall and ceiling mounted access units.

1.02 RELATED REQUIREMENTS

- A. Section 09 9000 - Painting and Coating

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work.

PART 2 PRODUCTS

2.01 ACCESS DOORS AND PANELS ASSEMBLIES

- A. Wall-Mounted Units:
 - 1. Location: As indicated on drawings.
 - 2. Panel Material: Aluminum extrusions with gypsum board inlay.
 - 3. Size: 12 by 12 inches.
 - 4. Door/Panel: Hinged, standard duty, with tool-operated spring or cam lock and no handle.
 - 5. Gypsum Board Mounting Criteria: Provide drywall bead frame with door surface flush with wall surface.
- B. Fire-Rated Wall-Mounted Units:
 - 1. Wall Fire-Rating: As indicated on drawings.
 - 2. Panel Material: Steel.
 - 3. Size: 12 by 12 inches.
 - 4. Door/Panel: Insulated double-surface panel, with tool-operated spring or cam lock and no handle.
- C. Ceiling-Mounted Units:
 - 1. Panel Material: Aluminum extrusion with gypsum board inlay.
 - 2. Size - Lay-In Grid Ceilings: To match module of ceiling grid.
 - 3. Size - Other Ceilings: 12 by 12 inches.
 - 4. Door/Panel: Hinged, standard duty, with tool-operated spring or cam lock and no handle.
- D. Fire-Rated Ceiling-Mounted Units:
 - 1. Ceiling Fire-Rating: As indicated on drawings.
 - 2. Panel Material: Steel.
 - 3. Size: 12 by 12 inches.
 - 4. Door/Panel: Hinged, standard duty, with tool-operated spring or cam lock and no handle.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that rough openings are correctly sized and located.

3.02 INSTALLATION

- A. Install units in accordance with manufacturer's instructions.
- B. Install frames plumb and level in openings, and secure units rigidly in place.
- C. Position units to provide convenient access to concealed equipment when necessary.

END OF SECTION

SECTION 08 5345
VINYL WINDOWS (BASIS OF DESIGN)

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Alpen Tyrol Series comprised of REHAU System 4700 fully welded glass-fiber reinforced vinyl (PVC) prime windows as listed below. All windows are factory assembled, and include all required glass and glazing materials; any internal structural metal reinforcement (stiffeners) that may be required (e.g. to meet design loads, mulling conditions, reinforcement of non-white vinyl and/or proper operation); window hardware, weatherstripping and insect screens.
 - 1. Size and Quantity of each type of vinyl window is as shown on drawings
 - 2. Configurations of windows required: (Note: "tilt-turn" is synonymous with "dual-action")
 - a. Prime Tilt-turn window
 - b. Fixed Windows
 - c. Custom configuration window(s)
- B. Related Sections:
 - 1. Section 07 92 00 Joint Sealants
 - 2. Section 08 15 20 Hinged Vinyl-Framed Glass Doors
 - 3. Section 08 80 00 Glass

1.02 REFERENCES

- A. Publications listed below are part of this specification to the extent they are referenced. When publications are cited in these specifications by use of shortened names or by standard number alone, it must be understood that reference is made to the full publication and edition as listed here.
- B. American Architectural Manufacturers Association (AAMA):
 - 1. AAMA/WDMA/CSA 101/I.S.2/A440-11, NAFS 2011 North American Fenestration Standard/Specification for windows, doors and skylights
 - 2. AAMA 303 -08, Voluntary Specification for Rigid Polyvinyl Chloride (PVC) Exterior Profiles
 - 3. AAMA 310 - 12, Voluntary Specifications for Reinforced Thermoplastic Fenestration Exterior Profile Extrusions
 - 4. AAMA 502 -11 Voluntary Specification for Field Testing of Windows and Sliding Glass Doors
 - 5. AAMA 800 – 10 Voluntary Specifications and Test Methods for Sealants
- C. American Society of Civil Engineers:
 - 1. ASCE 7 – 10 Minimum Design Loads for Buildings and Other Structures, ASCE/SEI 2005
- D. American Society for Testing and Materials
 - 1. ASTM E 90 -09 Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
 - 2. ASTM E 1332 – 10a, Standard Classification for Determination of Outdoor-Indoor Sound Attenuation
 - 3. German Institute for Standardization (Deutsches Institut für Normung)
 - a. DIN 18357 German construction contract procedures - Part C: General technical specifications for building works - Mounting of window and door fittings
 - b. DIN EN 10327, Continuously hot-dip coated strip or sheet of low-carbon steels for cold forming, Technical delivery conditions
 - 4. Glass Association of North America:
 - a. GANA Glazing Manual (2004)
 - 5. National Fenestration Rating Council, Inc.
 - a. NFRC 100 – 2010, Procedure for Determining Fenestration Product U-Factors

- b. NFRC 200 – 2010, Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence
 - c. NFRC 500 – 2010, Procedure for Determining Fenestration Product Condensation Resistance Values
 - d. NFRC 102 – 2010 Procedure for Measuring the Steady-State Thermal Transmittance of Fenestration Systems
6. PHIUS+ 2018
 7. REHAU Incorporated
 - a. System 4700 Technical Information, Profile Print
 - b. System 4700 Technical Information, Size Limitations
 - c. System 4700 Technical Information, Glazing Instructions
 - d. System 4700 Technical Information, Reinforcement Guidelines

1.03 SYSTEM DESCRIPTION

- A. Structural Design Requirements:
 1. Design Loads:
- B. Use this section to specify the required strength(s) of windows, keeping in mind that different window designs and different window sizes have different maximum strengths. Don't "over-specify"
- C. Window Design DP Window Rating
- D. "Residential Size" (47" x 59") 95 psf (AAMA Class R PG 95* (1200 x 1500) – DAW)
- E. "Commercial Size" (47" x 86") 70 psf (AAMA Class CW PG 70* (1200x 2180) –DAW)
- F. Windows shall be identical in construction to test windows that comply with all requirements of:
- G. AAMA 101 Performance Class R-PG *-DAW 47 x 59 at Building A AAMA 101 Performance Class CW PG *-DAW 47 x 86 at 4th Story of Building B, performance as determined by ASCE 7.
 1. Comply with all applicable Building Codes.
- H. Other Performance Requirements:
- I. Allow for thermal movement of the window based on site mean temperature +/- 70 °F, window/element size and coefficient of linear expansion of PVC.
 1. Thermal Performance:
 - a. Comply with all applicable energy codes and ENERGY STAR®
 - b. The windows, including glass and vinyl framing, shall have a thermal transmittance (U-factor) of <or = $[0.14 \text{ Btu/hr} \cdot \text{ft}^2 \cdot \text{°F}]$ d, when tested in compliance with NFRC 100-2010
 - c. The windows, including glass and vinyl framing, shall have a Solar heat gain coefficient (SHGC) of .40 at Building A and .37 at Building B when tested in compliance with EN ISO 410

1.04 SUBMITTALS

- A. Product Data:
 1. Manufacturer's printed literature describing specified products shall be submitted in accordance with Section 01 33 00.
 2. REHAU Incorporated printed literature describing quality of vinyl extrusions.
- B. Shop Drawings:
 1. Submit dimensioned shop drawings for system. Show materials, anchorage, field connections, sealants and glazing.
 2. Drawings shall show scale elevations and sections. Full size sections shall be shown only when needed for clarity.
- C. Samples:
 1. Selection Samples:

- a. Submit color samples displaying manufacturer's standard colors and finishes for initial selection by Architect. Submit actual material samples of colors and finishes available.
 - b. Sample Size: Not less than 6" length of vinyl profile
 - 1) Samples submitted shall be of production type and shall represent quality of finish to be furnished by manufacturer. No work represented by samples shall be fabricated until samples are accepted.
- D. Quality Assurance Submittals:
- 1. Test Reports:
 - a. Submit certified test reports from an AAMA accredited, independent testing laboratory showing system has been tested and meets or exceeds specified requirements and indicating full compliance with specified performance criteria.

1.05 QUALITY ASSURANCE

- A. Qualifications:
- 1. This portion of Work shall be provided by a single firm, who has specialized in the fabrication of fully welded vinyl windows and is trained in the application and adjustment of tilt-turn window hardware.
 - 2. The window fabricator shall be fully trained by a REHAU technical representative in the approved techniques and methods of fabricating System 4700 vinyl windows. Training or auditing shall have occurred within two years of the commencement of this project.
 - 3. The window fabricator shall be an authorized REHAU fabricator in good standing.
- B. Materials:
- 1. Only REHAU Quality vinyl extrusions and REHAU approved components shall be used.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Packing, Shipping, Handling, and Unloading:
- 1. A temporary covering shall protect exposed surfaces after completing fabrication of products.
 - 2. Deliver materials in manufacturer's original packaging with labels intact.
- B. Storage and Protection:
- 1. Store windows/elements vertically, inside, in a clean and dry location.
 - 2. Stacking shall be done in a way to prevent bending.
 - 3. Cover stacks in a manner to provide air circulation and to reasonably protect materials from damage.
 - 4. Keep on-site handling to a minimum. Exercise particular care to avoid damage to finishes. Damaged or deteriorated materials shall be removed from the site.

1.07 PROJECT CONDITIONS

- A. Environmental Requirements:
- 1. Do not proceed with jobsite sealant application when ambient and substrate temperature conditions are not within limits permitted by sealant manufacturer.
 - 2. Sealants shall not be applied when joint substrates are wet due to rain, frost, condensation or other causes.
- B. Field Measurements:
- 1. Verify dimensions of surrounding construction by field measurements so work will be accurately fabricated, and fitted to structure. Contractor and manufacturer shall cooperate to establish and maintain these field dimensions. If the contractor guarantees the dimensions, no field measurements are needed.

1.08 SPECIAL WARRANTY

- A. Provide a written warranty signed by both the window fabricator and the installer agreeing to repair or replace defective materials or workmanship, including evidence of early deterioration, weathering or aging of Work, uncontrolled water penetration or air infiltration, glass breakage due to design defects, deterioration of finishes, failure of operating parts to properly function and other deterioration or failure of Work to comply with performance or other requirements. Warranty shall be for a period of 5 years from Date of Substantial Completion.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Vinyl (PVC) Windows :
1. REHAU Window Designs as provided by Alpen High Performance Products (HPP)
 - a. Alpen High Performance Products
 - b. 6268 Monarch Park Pl.
 - c. Niwot, CO 80504
 2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 MATERIALS

- A. Window System: Alpen Tyrol Series Vinyl Window/Door System..
1. Windows on this project shall be furnished and installed in the sizes, configurations and quantities as described in the Project Contract Documents and within the allowed parameters in PART 1, Section 1 of this specification.
 2. All extruded vinyl shall be made from RAU PVC for supplementary profiles and RAU-FIPRO (weldable, glass fiber reinforced PVC) for main profiles such as frame sash and T-mullions
 3. Minimum Outside Nominal Wall Thickness:
 - a. Primary frame and sash extrusions' exterior walls: 0.106" (2.7 mm)
 - b. Secondary extrusions (e.g. glazing stops and closures): 0.067" (1.8 mm)
 - 1) Face Dimensions (nominal): As indicated on Architectural Drawings
 - 2) Window frames shall be multiple chambers in the frame providing structural strength, thermal insulation and separation of drainage passages from any metal reinforcing profiles.
 - 3) Window sash and frame shall be configured to receive glazing beads (stops) that snap in on the interior side of the glass for dry glazing applications.
 - 4) Glazing beads (stops) shall incorporate coextruded black RAU-PREN glazing seals.
- B. Reinforcement:
1. If required (see current Alpen Tyrol Series technical information), custom shaped steel reinforcements for the internal applications in windows and doors must be used.
 2. Galvanized steel specified according to EN 10327, Grade DX 51D+Z275-N-A-C
 3. Galvanized Steel shall be in size , configuration and location within the window as indicated in the test reports and REHAU System 4700, Reinforcement Instructions
 4. Reinforcement must be used in all main profiles (such as frame, sash or t-mullion), which are non-white
 5. Reinforcement must be used between windows, which are joined with each other and must be sufficiently sized and anchored according to the structural requirements.
- C. Weatherseals:
1. Black co-extruded polymer replaceable weatherseals:
 - a. Shapes, designs, and thickness as needed to satisfy performance requirements.
 - b. Replacement weatherseals shall be provided in continuous lengths, butted firm to ends of races and to each other when in the same planes.
- D. Glass:

1. Glass shall comply with requirements of AAMA/WDMA/CSA 101/I.S.2/A440-10, Section 10.2 and the GANA Glazing Manual.
2. TR-6 Balanced 6 PH plus TGT

2.03 ACCESSORIES

- A. Fasteners: Stainless Steel: AISI 300 Series
1. Fasteners shall be selected to prevent galvanic reaction with any reinforcement materials fastened.
 2. Above criteria is applicable to screws used to secure internal reinforcement and to fasteners used in window mulling connections, if required.
 3. Avoid exposed fasteners to greatest extent possible.
 4. Where exposed fasteners are unavoidable in finished surfaces, use flathead countersunk Phillips head screws.
 5. Installation anchors must be approved by the responsible engineer/architect for the project
- B. Sealants:
1. Sealants shall comply with requirements of AAMA 800

2.04 FABRICATION

- A. General Requirements:
1. Follow all requirements of the REHAU fabrication guidelines
 2. Miter cut and fusion weld (i.e. thermally weld) all frame and sash corners.
 3. Complete fabrication, assembly, finishing, hardware application, and other work for each individual window unit before shipment to Site. Field assembly to connect two or more muller windows is permitted.
 4. Provide baffled drainage holes to drain moisture to exterior.
- B. Welding:
1. Welding shall be done in compliance with applicable recommendations and shall be done with materials and equipment as recommended by REHAU.
 2. Welds shall be finished and dressed.
- C. System:
1. Window construction, edge clearance and placement of installation fasteners shall allow for expansion and contraction per the specified system performance requirements.
 2. Provisions shall be made in framing, including sash, for minimum glass edge clearance, nominal edge cover, and nominal pocket width, in compliance with GANA Glazing Manual, for thickness and type glass specified.
 3. Framing shall be provided with reinforcing members as necessary. Provide steel members as needed to reinforce frame, T-mullion and/or sash components as recommended by REHAU to develop needed strength of assembly.
- D. Hardware
1. Quality hardware is to be used for vinyl Tilt-turn Windows. Hardware shall meet the requirements according to the German Standard DIN 18357. Material used must be corrosion resistant. Ability for repair and maintenance must be given. The installation must be performed according to the guidelines given by the hardware manufacturer. The fastening of the hardware components has to be safe and secure, preferably into steel reinforcements or at least through 2 PVC walls, meeting the requirements for the actual loads of the sash. Fasteners have to be corrosion resistant.
 2. Provide sash limiters to limit window opening to 4" or less.
- E. Insect Screens
1. 1. Insect screens shall conform to AAMA 101, section 11.6
 2. 2. Insect screens are mounted on the outside of the window. They must be removable from the inside.

- F. Simulated Muntin Bars
 - 1. Provide muntin bars to inside and outside of glass surfaces as indicated on the drawings. Combination of 2" and 7/8".

2.05 SHOP FINISHES

- A. Protection:
 - 1. Provide film to protect exposed finished surfaces during shipment, storage, and installation whenever possible.
 - 2. Film shall not affect factory finish after finished component is installed and film is stripped, no residue, adhesive, or film covering, visual non-uniformity or other deleterious effects or substances shall remain on surfaces.
 - 3. Factory applied protective film must be removed immediately after installation.
 - 4. When cleaning agents/paint etc. are applied to the building the windows must be protected.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Site Verification of Conditions:
 - 1. Examine window openings and adjacent building structure where windows will be applied for conditions that will prevent proper execution of this portion of Work and endanger permanency.
 - 2. Do not proceed with installation until defects have been corrected.
 - 3. Verify sealant compatibility and adhesion to vinyl in conjunction with sealant manufacturer.

3.02 PREPARATION

- A. Coordination:
 - 1. Coordinate installation with work of other trades.

3.03 INSTALLATION

- A. General Requirements:
 - 1. Comply with manufacturer's instructions and recommendations for installation of work. Follow the state-of-the-art Installation Masters™ guidelines.
 - 2. Do not erect warped, bowed, deformed or otherwise damaged or defaced members. Replace materials that are damaged during installation as directed.
 - 3. Set units level, plumb, and true to line, with uniform joints. Support units on shims and secure in place by approved installation anchors/fasteners that properly engage into to supporting structure.
 - 4. Insulation must be used around the perimeter of the window in accordance with shop drawings, project drawings and the insulation manufacturer's guidelines. Insulation must allow for expansion and contraction of the installed window.
 - 5. Flashing and other materials used around window opening shall be corrosion resistant, non-staining, non-bleeding, and compatible with adjoining materials.
- B. Erection Tolerances:
 - 1. Variations from Plumb: $\pm 1/8$ " maximum in window height.
 - 2. Variations from Level: $\pm 1/8$ " maximum in 10' run, non-cumulative.

3.04 FIELD QUALITY CONTROL

- A. Field Check for Water Leakage:
 - 1. After completion of installation and nominal curing of sealant and glazing compounds, but before installation of interior finishes, perform AAMA 502 test. Architect will determine the quantity and type(s) of window(s) to be tested.
 - 2. In case of water penetration take corrective action and re-test as necessary until the problem is resolved.

3.05 ADJUSTING

- A. Weatherseal contact shall be checked and any required final hardware adjustment made for proper operation and performance of units.

3.06 CLEANING

- A. Clean completed system in compliance with manufacturer's recommendations, inside and out, promptly after erection and installation of glass and sealants. Remove excess glazing and joint sealants, dirt, and other substances from finished surfaces promptly after erection.
- B. Remove protective material from prefinished surfaces.
- C. Wash down exposed surfaces using a solution of mild detergent in warm water applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.

3.07 PROTECTION

- A. Institute protective measures and other precautions needed to assure Work will be without damage or deterioration, other than normal weathering, at time of acceptance.

END OF SECTION

**SECTION 08 7100
DOOR HARDWARE**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Hardware for wood, aluminum, and hollow metal doors.
- B. Hardware for fire-rated doors.
- C. Electrically operated and controlled hardware.
- D. Thresholds.
- E. Weatherstripping, seals and door gaskets.

1.02 REFERENCE STANDARDS

- A. BHMA A156.1 - American National Standard for Butts and Hinges; 2013.
- B. BHMA A156.2 - American National Standard for Bored and Preassembled Locks & Latches; 2011.
- C. BHMA A156.3 - American National Standard for Exit Devices; 2014.
- D. BHMA A156.4 - American National Standard for Door Controls - Closers; 2013.
- E. BHMA A156.7 - American National Standard for Template Hinge Dimensions; 2014.
- F. BHMA A156.8 - American National Standard for Door Controls - Overhead Stops and Holders; 2010.
- G. BHMA A156.12 - American National Standard for Interconnected Locks; 2013.
- H. BHMA A156.13 - American National Standard for Mortise Locks & Latches Series 1000; 2012.
- I. BHMA A156.15 - American National Standard for Release Devices - Closer Holder, Electromagnetic and Electromechanical; 2011.
- J. BHMA A156.18 - American National Standard for Materials and Finishes; 2012.
- K. BHMA A156.21 - American National Standard for Thresholds; 2014.
- L. BHMA A156.22 - American National Standard for Door Gasketing and Edge Seal Systems, Builders Hardware Manufacturers Association; 2012.
- M. BHMA A156.31 - American National Standard for Electric Strikes and Frame Mounted Actuators; 2013.
- N. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2016.
- O. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the manufacture, fabrication, and installation of products that door hardware will be installed upon. **Coordinate work with security vendor.**

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's catalog literature for each type of hardware, marked to clearly show products to be furnished for this project.
- C. Hardware Schedule: Detailed listing of each item of hardware to be installed on each door. Use door numbering scheme as included in the Contract Documents. Identify electrically operated items and include power requirements.
- D. Warranty: Submit manufacturer's warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
- B. Hardware Supplier Qualifications: Company specializing in supplying commercial door hardware with 10 years of experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Package hardware items individually; label and identify each package with door opening code to match hardware schedule.

1.07 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide 3 year warranty for door closers and interconnected locks.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Allegion Brands, LCN or Schlage: www.allegion.com/us.

2.02 MANUFACTURERS - BASIS OF DESIGN

- A. Unit Entry Doors Mortise Lockset: Schlage: S251 Series Interconnected Lock; Avila Lever.
- B. Interior Unit Hardware (Bed/ Bath/ Closet): Schlage Avila Lever with standard trim.
- C. Public Rooms / Office: Schlage AL Series cylindrical lock; Jupiter Series lever. **Provide tactile warning at hardware sets to hazardous areas.**

2.03 DOOR HARDWARE - GENERAL

- A. Provide hardware specified or required to make doors fully functional, compliant with applicable codes, and secure to the extent indicated.
- B. Provide items of a single type of the same model by the same manufacturer.
- C. Provide products that comply with the following:
 - 1. Applicable provisions of federal, state, and local codes.
 - 2. Fire-Rated Doors: NFPA 80.
 - 3. Hardware on Fire-Rated Doors, Except Hinges: Listed and classified by UL (DIR) as suitable for the purpose specified and indicated.
- D. Finishes: Provide door hardware of the same finish unless otherwise indicated.
 - 1. Primary Finish: Satin chrome plated over nickel on brass or bronze, 626 (approx US26D).
 - 2. Finish Definitions: BHMA A156.18.
 - 3. Exceptions:
 - a. Where base metal is specified to be different, provide finish that is an appearance equivalent according to BHMA A156.18.
 - b. Hinges for Fire-Rated Doors: Steel base metal with painted finish.

2.04 LOCKS AND LATCHES

- A. Locks: Provide a lock for every door, unless specifically indicated as not requiring locking.
 - 1. If no hardware set is indicated for a swinging door provide an office lockset.
 - 2. Trim: Provide lever handle or pull trim on outside of all locks unless specifically stated to have no outside trim.
 - 3. Lock Cylinders: Provide key access on outside of all locks unless specifically stated to have no locking or no outside trim.
- B. Lock Cylinders: Manufacturer's standard tumbler type, six-pin standard core.
 - 1. Provide cams and/or tailpieces as required for locking devices required.
- C. Keying: Grand master keyed. Coordinate with Owner

- D. Latches: Provide a latch for every door that is not required to lock, unless specifically indicated "push/pull" or "not required to latch".

2.05 HINGES

- A. Hinges: Provide hinges on every swinging door.
 - 1. Provide five-knuckle full mortise butt hinges unless otherwise indicated.
 - 2. Provide non-removable pins on exterior outswinging doors.
- B. Butt Hinges: Comply with BHMA A156.1 and BHMA A156.7; standard weight, unless otherwise indicated.
 - 1. Provide hinge width required to clear surrounding trim.
 - 2. Provide Spring type hinges at apartment entrance doors.
- C. Quantity of Hinges Per Door:
 - 1. Doors From 60 inches High up to 90 inches High: Three hinges.
 - 2. Doors 90 inches High up to 120 inches High: Four hinges.
- D. Manufacturers - Hinges:
 - 1. Hager Companies: www.hagerco.com.
 - 2. Stanley Black & Decker: www.stanleyblackanddecker.com.

2.06 LOCKS AND LATCHES

- A. Locks: Provide a lock for every door, unless specifically indicated as not requiring locking.
 - 1. Hardware Sets indicate locking functions required for each door.
 - 2. If no hardware set is indicated for a swinging door provide an office lockset.
 - 3. Trim: Provide lever handle or pull trim on outside of all locks unless specifically stated to have no outside trim.
 - 4. Lock Cylinders: Provide key access on outside of all locks unless specifically stated to have no locking or no outside trim.
- B. Lock Cylinders: Manufacturer's standard tumbler type, six-pin standard core.
 - 1. Provide cams and/or tailpieces as required for locking devices required.
- C. Keying: Grand master keyed.
- D. Latches: Provide a latch for every door that is not required to lock, unless specifically indicated "push/pull" or "not required to latch".

2.07 CYLINDRICAL LOCKSETS

- A. Cylindrical Locksets - Interior Units Basis of Design: Schlage Avila Lever, Standard Trim.
- B. Cylindrical Locksets - Public Rooms / Office: Schlage AL Lever Lockset ; Jupiter Lever
- C. Locking Functions: As defined in BHMA A156.2, and as follows.
 - 1. Passage: No locking, always free entry and exit.
 - 2. Privacy: F76, emergency tool unlocks.
- D. Manufacturers - Cylindrical Locksets:
 - 1. Schlage: www.schlage.com.

2.08 MORTISE LOCKSETS

- A. Mortise Locksets - Residential Units Entry Door - Basis of Design: Schlage-S251 Series Interconnected Lock; Avila Lever.
- B. Locking Functions: As defined in BHMA A156.13, and as follows:
- C. Manufacturers - Mortise Locksets:
 - 1. Schlage, an Allegion brand: www.allegion.com/us.

2.09 INTERCONNECTED LOCKSETS AT UNIT ENTRIES ONLY

- A. Interconnected Locksets - Basis of Design: Schlage-S251 Series Interconnected Lock; Avila Lever.
- B. Locking Functions: As defined in BHMA A156.12.
- C. Manufacturers - Interconnected Locksets:
 - 1. Schlage, An Allegion Brand : www.allegion.com/us

2.10 FLUSHBOLTS AND COORDINATORS

- A. Manufacturers - Flushbolts:
 - 1. Rockwood.

2.11 ELECTRIC STRIKES

- A. Electric Strikes: Complying with BHMA A156.31 and UL (DIR) listed as a Burglary-Resistant Electric Door Strike; style to suit locks.
- B. Manufacturers - Electric Strikes:
 - 1. Assa Abloy Brands, Folger Adam EDC, HES, or Securitron: www.assaabloydss.com.

2.12 EXIT DEVICES

- A. Locking Functions: Functions as defined in BHMA A156.3, and as follows:
- B. Manufacturers - Exit Devices:
 - 1. Von Duprin, an Allegion brand: www.allegion.com/us.

2.13 CLOSERS

- A. Closers: Complying with BHMA A156.4.
 - 1. Provide surface-mounted, door-mounted closers unless otherwise indicated.
 - 2. Provide a door closer on every exterior door.
 - 3. Provide a door closer on every fire- and smoke-rated door. Spring hinges are not an acceptable self-closing device unless specifically so indicated.
 - 4. On pairs of swinging doors, if an overlapping astragal is present, provide coordinator to ensure the leaves close in proper order.
 - 5. At corridors, locate door-mounted closer on room side of door.
- B. Manufacturers - Surface Mounted Closers:
 - 1. Assa Abloy Brands, Corbin Russwin, Norton, Rixson, Sargent, or Yale; _____ : www.assaabloydss.com.

2.14 DOOR VIEWER

- A. Manufacturer: Ives
- B. Style: 180 degree view
- C. Rating: 30 Minutes
- D. Finish: Satin Aluminum
- E. Installation: Provide 1 viewer at all doors, Provide 2 viewers at accessible units. Viewer at 60" A.F.F., Lower viewer mounted at 42" A.F.F.

2.15 STOPS AND HOLDERS

- A. Stops: Complying with BHMA A156.8; provide a stop for every swinging door, unless otherwise indicated.
 - 1. Provide floor stops, unless otherwise indicated.
 - 2. If floor stops are not practical, due to configuration of room or furnishings, provide wall stop.
 - 3. Stop is not required if positive stop feature is specified for door closer; positive stop feature of door closer is not an acceptable substitute for a stop unless specifically so stated.

- B. Magnetic Holder/Releases: Complying with BHMA A156.15; fail safe; doors release to close automatically when electrical current is interrupted; holding force: 25 to 40 pounds-force.
- C. Manufacturers - Wall and Floor Stops/holders:
 - 1. Hager Companies: www.hagerco.com.

2.16 GASKETING AND THRESHOLDS

- A. Gaskets: Complying with BHMA A156.22.
 - 1. On each exterior door, provide weatherstripping gaskets, unless otherwise indicated; top, sides, and meeting stiles of pairs.
 - a. Where exterior door is also required to have fire or smoke rating, provide gaskets functioning as both smoke and weather seals.
 - 2. **On each exterior door, provide door bottom sweep made of a solid material (not a brush), unless otherwise indicated.**
- B. Thresholds: Complying with BHMA A156.21.
 - 1. Type: Thermally Broken Aluminum
 - 2. Size: 6 " width
 - 3. Finish: Mill Finish Aluminum
 - 4. Accessibility: ADA Compliant
 - 5. At each exterior door, provide a threshold unless otherwise indicated.
- C. Manufacturers - Gasketing and Thresholds:
 - 1. Hager Companies: www.hagerco.com.

2.17 PROTECTION PLATES AND ARCHITECTURAL TRIM

- A. Manufacturers - Protection Plates and Architectural Trim:
 - 1. Rockwood Manufacturing Company, an Assa Abloy brand: www.rockwoodmfg.com.

2.18 KEY CONTROLS

- A. Facility Manager's Key Cabinet: Sheet steel construction, piano hinged door with key lock.
 - 1. Mounting: Wall-mounted.
 - 2. Capacity: Actual quantity of keys, plus 25 percent additional capacity.
 - 3. Horizontal metal hook strips with replaceable labels covered with clear plastic.
 - 4. Size key hooks to hold 6 keys each.
 - 5. Finish: Baked enamel, manufacturer's standard color.
 - 6. Key cabinet lock to building keying system.
 - 7. Manufacturers - Key Controls:
 - a. Telkee.

2.19 FIRE DEPARTMENT LOCK BOX

- A. Fire Department Lock Box: Heavy-duty, surface mounted, solid stainless-steel box with hinged door and interior gasket seal; single drill resistant lock with dust covers and tamper alarm.
 - 1. Capacity: Holds 10 keys.
 - 2. Finish: Manufacturer's standard dark bronze.
 - 3. Manufacturers - Fire Department Lock Box:
 - a. Knox Company; Knox-Box Rapid Entry System: www.knoxbox.com.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that doors and frames are ready to receive work; labeled, fire-rated doors and frames are present and properly installed, and dimensions are as indicated on shop drawings.
- B. **Coordinate all hardware with Security Specifications on drawings SEC-1 through SEC-20.**

- C. Verify that electric power is available to power operated devices and of the correct characteristics.

3.02 INSTALLATION

- A. Install hardware in accordance with manufacturer's instructions and applicable codes.
- B. Use templates provided by hardware item manufacturer.
- C. Install hardware on fire-rated doors and frames in accordance with code and NFPA 80.
- D. Mounting heights for hardware from finished floor to center line of hardware item.
- E. Set exterior door thresholds with full-width bead of elastomeric sealant on each point of contact with floor providing a continuous weather seal; anchor thresholds with stainless steel countersunk screws.

3.03 ADJUSTING

- A. Adjust work under provisions of Section 01 7000 - Execution and Closeout Requirements.
- B. Adjust hardware for smooth operation.

3.04 CLEANING

- A. Clean adjacent surfaces soiled by hardware installation. Clean finished hardware per manufacturer's instructions after final adjustments has been made. Replace items that cannot be cleaned to manufacturer's level of finish quality at no additional cost.

END OF SECTION

SECTION 09 2117
GYPSUM BOARD

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Performance criteria for gypsum board assemblies.
- B. Gypsum wallboard.
- C. Joint treatment and accessories.

1.02 REFERENCE STANDARDS

- A. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2015.
- B. ASTM C514 - Standard Specification for Nails for the Application of Gypsum Board; 2004 (Reapproved 2014).
- C. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2014.
- D. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2012.
- E. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2015.
- F. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2013.
- G. ASTM C1047 - Standard Specification for Accessories For Gypsum Wallboard and Gypsum Veneer Base; 2014a.
- H. ASTM C1178/C1178M - Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel; 2013.
- I. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2014.
- J. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2012.
- K. GA-216 - Application and Finishing of Gypsum Board; 2013.
- L. UL (FRD) - Fire Resistance Directory; current edition.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on metal framing, gypsum board, accessories, and joint finishing system.

PART 2 PRODUCTS

2.01 GYPSUM BOARD ASSEMBLIES

- A. Provide completed assemblies complying with ASTM C840 and GA-216.
- B. Fire-Resistance-Rated Assemblies: Provide completed assemblies with the following characteristics: See drawings for specific assemblies and ratings.
 - 1. UL Assembly Numbers: Provide construction equivalent to that listed for the particular assembly in the current UL (FRD).

2.02 METAL FRAMING MATERIALS

- A. Manufacturers - Metal Framing, Connectors, and Accessories:
 - 1. Clarkwestern Dietrich Building Systems LLC: www.clarkdietrich.com.
 - 2. Marino: www.marinoware.com.
 - 3. Substitutions: See Section 01 6000 - Product Requirements.

- B. Non-structural Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/120 at 5 psf.
 - 1. Resilient Furring Channels: Single or double leg configuration; 1/2 inch channel depth.
 - a. Products:
 - 1) Same manufacturer as other framing materials.
- C. Shaft Wall Studs and Accessories: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 and specified performance requirements.

2.03 BOARD MATERIALS

- A. Manufacturers - Gypsum-Based Board:
 - 1. American Gypsum Company: www.americangypsum.com.
 - 2. CertainTeed Corporation: www.certainteed.com.
 - 3. Georgia-Pacific Gypsum: www.gpgypsum.com.
- B. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
 - 1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
 - 2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 - 3. At Assemblies Indicated with Fire-Resistance Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
 - 4. Thickness:
 - a. Vertical Surfaces: 5/8 inch.
 - b. Ceilings: 5/8 inch.
 - c. Multi-Layer Assemblies: Thicknesses as indicated on drawings.
 - 5. Glass Mat Faced Products: **Use at bathroom and laundry areas**
 - a. Georgia-Pacific Gypsum; DensArmor Plus: www.gpgypsum.com/#sle.
 - b. National Gypsum Company; Gold Bond eXP Interior Extreme Gypsum Panel: www.nationalgypsum.com/#sle.
 - c. USG Corporation; USG Sheetrock Brand Glass-Mat Panels Mold Tough.
 - d. Substitutions: See Section 01 6000 - Product Requirements.
- C. Backing Board For Bathrooms and Laundries: One of the following products:
 - 1. Glass Mat Faced Board: Coated glass mat water-resistant gypsum backing panel as defined in ASTM C1178/C1178M.
 - a. Regular Type: Thickness 1/2 inch.
 - b. Fire-Resistance-Rated Type: Type X core, thickness 5/8 inch.
 - c. Products:
 - 1) CertainTeed Corporation; Diamondback 1/2" Tile Backer: www.certainteed.com/#sle.
 - 2) Georgia-Pacific Gypsum; DensShield Tile Backer: www.gpgypsum.com/#sle.
 - 3) Substitutions: See Section 01 6000 - Product Requirements.
- D. Shaftwall and Coreboard: Type X; 1 inch thick by 24 inches wide, beveled long edges, ends square cut.
 - 1. Paper-Faced Type: Gypsum shaftliner board or gypsum coreboard as defined ASTM C1396/C1396M; water-resistant faces.

2.04 GYPSUM WALLBOARD ACCESSORIES

- A. Acoustic Insulation: ASTM C665; preformed glass fiber, friction fit type, unfaced. Thickness: 3 1/2 inch.
- B. Acoustic Sealant: As specified in Section 07 9200.
- C. Beads, Joint Accessories, and Other Trim: ASTM C1047, rigid plastic or galvanized steel, unless noted otherwise.

- D. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
 - 1. Fiberglass Tape: 2 inch wide, coated glass fiber tape for joints and corners, except as otherwise indicated.
 - 2. Joint Compound: Setting type, field-mixed.
- E. Screws for Attachment to Wood Members: ASTM C514.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that project conditions are appropriate for work of this section to commence.

3.02 SHAFT WALL INSTALLATION

- A. Shaft Wall Framing: Install in accordance with manufacturer's installation instructions.
- B. Shaft Wall Liner: Cut panels to accurate dimensions and install sequentially between special friction studs.
 - 1. On walls over sixteen feet high, screw-attach studs to runners top and bottom.
 - 2. Seal perimeter of shaft wall and penetrations with acoustical sealant.

3.03 FRAMING INSTALLATION

- A. Acoustic Furring: Install resilient channels at maximum 24 inches on center. Locate joints over framing members.
- B. Blocking: Install wood blocking for support of:
 - 1. Framed openings.
 - 2. Wall-mounted cabinets.
 - 3. Toilet accessories.
 - 4. Wall-mounted door hardware.

3.04 ACOUSTIC ACCESSORIES INSTALLATION

- A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.
- B. Acoustic Sealant: Install in accordance with manufacturer's instructions.

3.05 BOARD INSTALLATION

- A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.
- B. Fire-Resistance-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.
- C. Installation on Wood Framing: For rated assemblies, comply with requirements of listing authority. For nonrated assemblies, install as follows:
 - 1. Single-Layer Applications: Screw attachment.

3.06 INSTALLATION OF TRIM AND ACCESSORIES

- A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.
 - 1. Not more than 30 feet apart on walls and ceilings over 50 feet long.
- B. Corner Beads: Install at external corners, using longest practical lengths.
- C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.

3.07 JOINT TREATMENT

- A. Glass Mat Faced Gypsum Board and Exterior Glass Mat Faced Sheathing: Use fiberglass joint tape, embed and finish with setting type joint compound.

- B. Paper Faced Gypsum Board: Use paper joint tape, embed with drying type joint compound and finish with drying type joint compound.
- C. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
 - 1. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
 - 2. Level 2: In utility areas, behind cabinetry, and on backing board to receive tile finish.
 - 3. Level 1: Fire-resistance-rated wall areas above finished ceilings, whether or not accessible in the completed construction.
- D. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
 - 1. Feather coats of joint compound so that camber is maximum 1/32 inch.

END OF SECTION

SECTION 09 2216

NON-STRUCTURAL METAL FRAMING- ALTERNATE # ARC-3

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Metal partition, ceiling, and soffit framing at non-bearing interior walls

1.02 REFERENCE STANDARDS

- A. AISI S100 - North American Specification for the Design of Cold-Formed Steel Structural Members; 2016.
- B. AISI S100-12 - North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 2012.
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- D. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2014.
- E. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2015.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data describing framing member materials and finish, product criteria, load charts, and limitations.
- C. Product Data: Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Metal Framing, Connectors, and Accessories:
 - 1. ClarkDietrich: www.clarkdietrich.com/#sle.
 - 2. Marino: www.marinoware.com/#sle.
 - 3. The Steel Network, Inc: www.SteelNetwork.com/#sle.
 - 4. Substitutions: See Section 01 6000 - Product Requirements.

2.02 FRAMING MATERIALS

- A. Non-Loadbearing Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/240 at 5 psf.
 - 1. Studs: C shaped with knurled or embossed faces.
 - 2. Runners: U shaped, sized to match studs.
 - 3. Resilient Furring Channels: Single or double leg configuration; 1/2 inch channel depth.
 - a. Products:
 - 1) ClarkDietrich; RC Deluxe Resilient Channel: www.clarkdietrich.com/#sle.
 - 2) Substitutions: See Section 01 6000 - Product Requirements.
- B. Partition Head to Structure Connections: Provide mechanical anchorage devices that accommodate deflection using slotted holes, screws, and anti-friction bushings, preventing rotation of studs while maintaining structural performance of partition.
 - 1. Structural Performance: Maintain lateral load resistance and vertical movement capacity required by applicable code, when evaluated in accordance with AISI S100.
 - 2. Material: ASTM A653/A653M steel sheet, SS Grade 50, with G60/Z180 hot-dipped galvanized coating.

2.03 FABRICATION

- A. Fabricate assemblies of framed sections to sizes and profiles required.
- B. Fit, reinforce, and brace framing members to suit design requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.

3.02 INSTALLATION OF STUD FRAMING

- A. Extend partition framing to structure where indicated and to ceiling in other locations.
- B. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.
- C. Partitions Terminating at Structure: Attach top runner to structure, maintain clearance between top of studs and structure, and connect studs to track using specified mechanical devices in accordance with manufacturer's instructions; verify free movement of top of stud connections; do not leave studs unattached to track.
- D. Align and secure top and bottom runners at 24 inches on center.
- E. Fit runners under and above openings; secure intermediate studs to same spacing as wall studs.
- F. Align stud web openings horizontally.
- G. Secure studs to tracks using fastener method. Do not weld.
- H. Fabricate corners using a minimum of three studs.
- I. Install double studs at wall openings, door and window jambs, not more than 2 inches from each side of openings.
- J. Coordinate installation of bucks, anchors, and blocking with electrical, mechanical, and other work to be placed within or behind stud framing.

END OF SECTION

SECTION 09 3000

TILING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Tile for floor applications.
- B. Tile for wall applications.
- C. Cementitious backer board as tile substrate.
- D. Stone thresholds.

1.02 REFERENCE STANDARDS

- A. ANSI A108.1a - American National Standard Specifications for Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar; 2014.
- B. ANSI A108.1b - American National Standard Specifications for Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex-Portland Cement Mortar; 1999 (Reaffirmed 2010).
- C. ANSI A108.1c - Specifications for Contractors Option: Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar or Installation of Ceramic Tile on a Cured Portland Cement Mortar Bed with Dry-Set or Latex-Portland Cement; 1999 (Reaffirmed 2010).
- D. ANSI A108.2 - American National Standard General Requirements: Materials, Environmental and Workmanship; 2019.
- E. ANSI A108.4 - American National Standard Specifications for Installation of Ceramic Tile with Organic Adhesives or Water Cleanable Tile-Setting Epoxy Adhesive; 2009 (Revised).
- F. ANSI A108.5 - American National Standard Specifications for Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar; 1999 (Reaffirmed 2010).
- G. ANSI A108.6 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy; 1999 (Reaffirmed 2010).
- H. ANSI A108.8 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant Furan Resin Mortar and Grout; 1999 (Reaffirmed 2010).
- I. ANSI A108.9 - American National Standard Specifications for Installation of Ceramic Tile with Modified Epoxy Emulsion Mortar/Grout; 1999 (Reaffirmed 2010).
- J. ANSI A108.10 - American National Standard Specifications for Installation of Grout in Tilework; 1999 (Reaffirmed 2010).
- K. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units; 2010 (Reaffirmed 2016).
- L. ANSI A108.12 - American National Standard for Installation of Ceramic Tile with EGP (Exterior glue plywood) Latex-Portland Cement Mortar; 1999 (Reaffirmed 2010).
- M. ANSI A108.13 - American National Standard for Installation of Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone; 2005 (Reaffirmed 2010).
- N. ANSI A108.19 - American National Standard Specifications for Interior Installation of Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs by the Thin-Bed Method Bonded with Modified Dry-Set Cement Mortar or Improved Modified Dry-Set Cement Mortar; 2017.
- O. ANSI A118.4 - American National Standard Specifications for Modified Dry-Set Cement Mortar; 2012 (Revised).

- P. ANSI A118.7 - American National Standard Specifications for High Performance Cement Grouts for Tile Installation; 2010 (Revised).
- Q. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 1999 (Reaffirmed 2016).
- R. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation; 2015.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.

1.04 QUALITY ASSURANCE

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

1.06 FIELD CONDITIONS

- A. Do not install solvent-based products in an unventilated environment.
- B. Maintain ambient and substrate temperature above 50 degrees F and below 100 degrees F during installation and curing of setting materials.

PART 2 PRODUCTS

2.01 TILE

- A. Porcelain Wall Tile, Type T-1: NEMO.
 - 1. Size: 5.9 by 6.7 inch, nominal.
 - 2. Color(s): Bianco Matte 6400.
 - 3. Pattern: Gramercy.
- B. Ceramic Wall Tile, Type T-2: NEMO.
 - 1. Size: 3 by 6 inch, nominal.
 - 2. Color(s): White.
 - 3. Pattern: Metro.
- C. Porcelain Tile, Type PFT-1: DalTile ; VertuoStria Composer VR14.
 - 1. Size: 8 by 48 inch, nominal.
 - 2. Color(s): Stria Composer VR14.

2.02 TRIM AND ACCESSORIES

- A. Thresholds: 2 inches wide by full width of wall or frame opening; beveled edge on both long edges; without holes, cracks, or open seams.
 - 1. Thickness: 1/2 inch.
 - 2. Material: Marble, honed finish.
 - 3. Color and Pattern: TBD.
 - 4. Applications:
 - a. At doorways where tile terminates.
 - b. At open edges of floor tile where adjacent finish is a different height.

2.03 SETTING MATERIALS

- A. Latex-Portland Cement Mortar Bond Coat: ANSI A118.4 or ANSI A118.15.

2.04 GROUTS

- A. High Performance Polymer Modified Grout: ANSI A118.7 polymer modified cement grout.
 - 1. Applications: Use this type of grout where indicated and where no other type of grout is indicated.
 - 2. Use sanded grout for joints 1/8 inch wide and larger; use unsanded grout for joints less than 1/8 inch wide.

3. Color(s): As selected by Architect from manufacturer's full line.
- B. Stain Resistant Grout Additive: Liquid admixture for sanded and unsanded cement-based grouts; mix with dry grout material in place of water.
 1. Applications: All grouted areas.
 2. Products:
 - a. AquaTight Grout additive.
 - b. Mapei Grout Maximizer.
 - c. Substitutions: See Section 01 6000 - Product Requirements.

2.05 MAINTENANCE MATERIALS

- A. Grout Sealer: Liquid-applied, moisture and stain protection for existing or new Portland cement grout.
 1. Composition: Water-based colorless silicone.

2.06 ACCESSORY MATERIALS

- A. Backer Board: Cementitious type complying with ANSI A118.9; high density, glass fiber reinforced, 1/2 inch thick; 2 inch wide coated glass fiber tape for joints and corners.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that subfloor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive tile.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive tile.
- C. Verify that subfloor surfaces are dust free and free of substances that could impair bonding of setting materials to subfloor surfaces.

3.02 PREPARATION

- A. Protect surrounding work from damage.
- B. Vacuum clean surfaces and damp clean.
- C. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.
- D. Install backer board in accordance with ANSI A108.11 and board manufacturer's instructions. Tape joints and corners, cover with skim coat of setting material to a feather edge.

3.03 INSTALLATION - GENERAL

- A. Install tile, thresholds, and stair treads and grout in accordance with applicable requirements of ANSI A108.1a through ANSI A108.19, manufacturer's instructions, and TCNA (HB) recommendations.
- B. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.
- C. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor joints.
- D. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.
- E. Form internal angles square and external angles bullnosed.
- F. Install thresholds where indicated.
- G. Sound tile after setting. Replace hollow sounding units.
- H. Keep control and expansion joints free of mortar, grout, and adhesive.
- I. Prior to grouting, allow installation to completely cure; minimum of 48 hours.

- J. Grout tile joints unless otherwise indicated. Use standard grout unless otherwise indicated.
- K. At changes in plane and tile-to-tile control joints, use tile sealant instead of grout, with either bond breaker tape or backer rod as appropriate to prevent three-sided bonding.

3.04 INSTALLATION - FLOORS - THIN-SET METHODS

- A. Over wood substrate with backer board underlayment, install in accordance with TCNA (HB) Method F144, for cementitious backer boards, with standard grout.

3.05 INSTALLATION - WALL TILE

- A. Over coated glass mat backer board on studs, install in accordance with TCNA (HB) Method W245.

3.06 CLEANING

- A. Clean tile and grout surfaces.

END OF SECTION

**SECTION 09 5100
ACOUSTICAL CEILINGS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Suspended metal grid ceiling system.
- B. Acoustical units.

1.02 REFERENCE STANDARDS

- A. ASTM C635/C635M - Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2013a.
- B. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2014.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.
- B. Do not install acoustical units until after interior wet work is dry.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on suspension system components and acoustical units.
- C. Samples: Submit two samples 6 by 6 inch in size illustrating material and finish of acoustical units.

1.05 QUALITY ASSURANCE

- A. Suspension System Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years experience.
- B. Acoustical Unit Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years experience.

1.06 FIELD CONDITIONS

- A. Maintain uniform temperature of minimum 60 degrees F, and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Acoustic Tiles/Panels:
 - 1. Armstrong World Industries, Inc: www.armstrong.com/#sle.
 - 2. CertainTeed Corporation: www.certainteed.com/#sle.
- B. Suspension Systems:
 - 1. Same as for acoustical units.

2.02 ACOUSTICAL UNITS

- A. Acoustical Panels: Painted mineral fiber, with the following characteristics:
 - 1. Classification: ASTM E1264 Type III.
 - 2. Size: 24 by 24 inches.
 - 3. Thickness: 3/4 inch.
 - 4. Panel Edge: Tegular.
 - 5. Suspension System: Exposed grid.
 - 6. Products:

- a. Armstrong World Industries, Inc; Ultima: www.armstrongceilings.com/#sle.
- b. Substitutions: See Section 01 6000 - Product Requirements.

2.03 SUSPENSION SYSTEM(S)

- A. Metal Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with perimeter moldings, stabilizer bars, clips, and splices as required.
- B. Exposed Suspension System: Hot-dipped galvanized steel grid.
 1. Structural Classification: Intermediate-duty, when tested in accordance with ASTM C635/C635M.
 2. Profile: Slotted Reveal Tee; 9/16 inch face width, with 1/8 inch center reveal.
 3. Finish: Baked enamel.
 4. Color: White.
 5. Products:
 - a. Armstrong; Silhouette 1/8" Reveal.

2.04 ACCESSORIES

- A. Support Channels and Hangers: Galvanized steel; size and type to suit application and ceiling system flatness requirement specified.
- B. Hanger Wire: 12 gauge, 0.08 inch galvanized steel wire.
- C. Perimeter Moldings: Same metal and finish as grid.
- D. Touch-up Paint: Type and color to match acoustical and grid units.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that layout of hangers will not interfere with other work.

3.02 INSTALLATION - SUSPENSION SYSTEM

- A. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.
- B. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
 1. Use longest practical lengths.
- C. Suspension System, Non-Seismic: Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.
- D. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.
- E. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.
- F. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.
- G. Do not eccentrically load system or induce rotation of runners.

3.03 INSTALLATION - ACOUSTICAL UNITS

- A. Install acoustical units in accordance with manufacturer's instructions.
- B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.
- C. Fit border trim neatly against abutting surfaces.
- D. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.
- E. Cutting Acoustical Units:

1. Make field cut edges of same profile as factory edges.

3.04 TOLERANCES

- A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.
- B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

END OF SECTION

**SECTION 09 6500
RESILIENT FLOORING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Resilient sheet flooring.
- B. Resilient tile/Plank flooring.
- C. Resilient base.
- D. Resilient stair accessories.
- E. Installation accessories.

1.02 REFERENCE STANDARDS

- A. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source; 2014c.
- B. ASTM F1066 - Standard Specification for Vinyl Composition Floor Tile; 2004 (Reapproved 2014).
- C. ASTM F1700 - Standard Specification for Solid Vinyl Tile; 2013a.
- D. ASTM F1861 - Standard Specification for Resilient Wall Base; 2008 (Reapproved 2012).
- E. ASTM F2169 - Standard Specification for Resilient Stair Treads; 2015.
- F. FS RR-T-650 - Treads, Metallic and Nonmetallic, Skid Resistant; Federal Specifications and Standards; Revision E, 1994.
- G. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source; 2015.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
- C. Selection Samples: Submit manufacturer's complete set of color samples for Architect's initial selection.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Protect roll materials from damage by storing on end.

1.05 FIELD CONDITIONS

- A. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

PART 2 PRODUCTS

2.01 TILE FLOORING

2.02 SEE SECTION 012300 ALTERNATES FOR PRICING AFFECTING WALL BASE IN THIS SECTION.

- A. Vinyl Composition Tile: VCT-1.
 - 1. Manufacturers:
 - a. Armstrong Flooring, Inc; Striations: www.armstrongflooring.com/#sle.
 - b. Substitutions: See Section 01 6000 - Product Requirements.
 - 2. Minimum Requirements: Comply with ASTM F1066, of Class corresponding to type specified.

3. Size: 12 by 12 inch.
 4. VOC Content Limits: As specified in Section 01 6116.
 5. Colors: Twilight.
 6. Install: Full spread glue
- B. Luxury Vinyl Tile: LVT-1.
1. Manufacturers:
 - a. Patcraft: www.patcraft.com
 - b. Substitutions: See Section 01 6000 - Product Requirements.
 2. Minimum Requirements: Comply with ASTM F1700, of Class corresponding to type specified.
 3. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E 648 or NFPA 253.
 4. Plank Size: 12 by 32.5 inch.
 5. Pattern: Wood Planx Facet.
 6. Color: Aged Maple.
 7. Installation Pattern: Ashlar
- C. Luxury Vinyl Tile: LVT-2
1. Manufacturers:
 - a. Patcraft: www.patcraft.com
- D. Minimum Requirements: Comply with ASTM F1700, of Class corresponding to type specified.
- E. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E 648 or NFPA 253.
- F. Plank Size: 7 by 48.03 inch.
- G. Pattern: Timber Grove II.
- H. Color: Yarrow.
- I. Installation Pattern: TBD
- J. Luxury Vinyl Tile: LVT-3
1. Manufacturer's:
 - a. Shaw Contract
 2. Pattern: Terrain II
 3. Color: Ash
- K. Vinyl Tile - Type ____: Printed film type, with transparent or translucent wear layer; acoustic interlayer or backing.
1. Manufacturers:
 2. Minimum Requirements: Comply with ASTM F1700, Class III.
 3. Wear Layer Thickness: 0.020 inch.
 4. Total Thickness: 0.20 inch.

2.03 STAIR COVERING

- A. Stair Treads/ Risers: Rubber; full width and depth of stair tread in one piece; tapered thickness; nosing not less than 1-5/8 inch deep.
1. Manufacturers:
 - a. Johnsonite, a Tarkett Company; Angle fit stair treads with integrated riser: www.johnsonite.com/#sle.
 - b. Substitutions: See Section 01 6000 - Product Requirements.
 2. Minimum Requirements: Comply with ASTM F2169, Type TP, rubber, thermoset.
 3. Minimum Requirements: Comply with FS RR-T-650 requirements corresponding to type specified.
 4. Nominal Thickness: 0.1875 inch.
 5. Nosing: Square.
 6. Texture: Hammered Tread/Riser HNTR.

7. Color: TBD.
- B. Stair Stringers: Full height in one piece and in maximum available lengths, matching base material and color at stair landings.
 1. Manufacturers:
 - a. Johnsonite, a Tarkett Company: www.johnsonite.com/#sle.
 2. Nominal Thickness: 0.080 inch.

2.04 RESILIENT BASE

- A. Resilient Base: ASTM F1861, Type TS rubber, vulcanized thermoset; top set Style A at Carpet, Style B at Resilient Floor.
 1. Manufacturers:
 - a. Johnsonite, a Tarkett Company: www.johnsonite.com/#sle.
 2. Height: 4 inch.
 3. Thickness: 0.125 inch.
 4. Finish: Satin.
 5. Length: Roll.
 6. Color: To be selected by Architect from manufacturer's full range.

2.05 ACCESSORIES

- A. Subfloor Filler: White premix latex; type recommended by adhesive material manufacturer.
- B. Primers, Adhesives, and Seam Sealer: Waterproof; types recommended by flooring manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resilient base.

3.02 PREPARATION

- A. Remove subfloor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with subfloor filler to achieve smooth, flat, hard surface.
- B. Prohibit traffic until filler is fully cured.

3.03 INSTALLATION - GENERAL

- A. Starting installation constitutes acceptance of subfloor conditions.
- B. Install in accordance with manufacturer's written instructions.

3.04 INSTALLATION - SHEET FLOORING

- A. Lay flooring with joints and seams parallel to longer room dimensions, to produce minimum number of seams. Lay out seams to avoid widths less than 1/3 of roll width; match patterns at seams.

3.05 INSTALLATION - TILE FLOORING

- A. Mix tile from container to ensure shade variations are consistent when tile is placed, unless otherwise indicated in manufacturer's installation instructions.
- B. Lay flooring with joints and seams parallel to building lines to produce symmetrical pattern.

3.06 INSTALLATION - LVT

- A. Install in accordance with underlayment manufacturer's instructions.

- B. Mix planks from container to ensure shade variations are consistent when plank is placed, unless otherwise indicated in manufacturer's installation instructions.
- C. Lay flooring with joints and seams parallel to building lines to produce symmetrical pattern.
- D. Install plank tile with a random offset of at least 6 inches from adjacent rows.

3.07 INSTALLATION - RESILIENT BASE

- A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.
- B. Install base on solid backing. Bond tightly to wall and floor surfaces.

3.08 INSTALLATION - STAIR COVERINGS

- A. Install stringers configured tightly to stair profile.
- B. Adhere over entire surface. Fit accurately and securely.

3.09 CLEANING

- A. Remove excess adhesive from floor, base, and wall surfaces without damage.
- B. Clean in accordance with manufacturer's written instructions.

END OF SECTION

SECTION 09 6813
TILE CARPETING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Carpet Tile, fully adhered.
- B. Broadloom Carpet, Fully Adhered

1.02 REFERENCE STANDARDS

- A. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source; 2014c.
- B. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source; 2015.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.
- C. Samples: Submit two carpet tiles illustrating color and pattern design for each carpet color selected.

1.04 FIELD CONDITIONS

- A. Store materials in area of installation for minimum period of 24 hours prior to installation.

PART 2 PRODUCTS (SEE SECTION 01 2300 ALTERNATES AFFECTING THIS SECTION)

2.01 MANUFACTURERS

- A. Tile Carpeting:
 - 1. Interface, Inc: www.interface.com/#sle.
 - 2. Shaw;www.shawcontract.com

2.02 MATERIALS

- A. Tile Carpeting, Type CPT-1: Tufted pattern loop, manufactured in one color dye lot.
 - 1. Product: Bees Knees manufactured by Interface.
 - 2. Tile Size: 19.69 x 19.69 inch, nominal.
 - 3. Tufted Weight: 25 oz/ sq. yd.
 - 4. Color: Fawn.
 - 5. Critical Radiant Flux: Minimum of 0.22 watts/sq cm, when tested in accordance with ASTM E648 or NFPA 253.
- B. Carpeting, Type [CPT-2]: [Tufted nylon], manufactured in one color dye lot.
 - 1. Product: [Imagery] manufactured by Shaw Contract
 - 2. Color: Tranquil
 - 3. Tufted Weight: 29 oz.
 - 4. Critical Radiant Flux: Minimum of 0.22 watts/sq cm, when tested in accordance with ASTM E648 or NFPA 253.
- C. Tile Carpeting, Type WOM-1: Multi Level Pattern Loop, manufactured in one color dye lot.
 - 1. Product: Super Nop 52 manufactured by Mats, Inc..
 - 2. Color: Black Walnut.
 - 3. Critical Radiant Flux: Minimum of 0.22 watts/sq cm, when tested in accordance with ASTM E648 or NFPA 253.

2.03 ACCESSORIES

- A. Subfloor Filler: White premix latex; type recommended by flooring material manufacturer.
- B. Edge Strips: Embossed aluminum, mill color.
- C. Adhesives:
 - 1. Compatible with materials being adhered; maximum VOC content as specified in Section 01 6116.
- D. Carpet Tile Adhesive: Recommended by carpet tile manufacturer; releasable type.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that subfloor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive carpet tile.

3.02 PREPARATION

- A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.

3.03 INSTALLATION

- A. Starting installation constitutes acceptance of subfloor conditions.
- B. Install carpet tile in accordance with manufacturer's instructions.
- C. Blend carpet from different cartons to ensure minimal variation in color match.
- D. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.
- E. Lay CPT-1 carpet tile in TBD pattern, with pile direction parallel to next unit, set parallel to building lines.
- F. Lay EM-1 carpet tile in [Quarter turn] pattern, with pile direction parallel to next unit, set parallel to building lines.
- G. Fully adhere carpet tile to substrate.
- H. Trim carpet tile neatly at walls and around interruptions.
- I. Complete installation of edge strips, concealing exposed edges.

3.04 CLEANING

- A. Remove excess adhesive without damage, from floor, base, and wall surfaces.
- B. Clean and vacuum carpet surfaces.

END OF SECTION

SECTION 09 6816
SHEET CARPETING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Carpet, direct-glued.

1.02 RELATED REQUIREMENTS

- A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

1.03 REFERENCE STANDARDS

- A. CRI 104 - Standard for Installation of Commercial Carpet; 2015.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.
- C. Samples: Submit two samples 18" by 18" inch in size illustrating color and pattern for each carpet and cushion material specified.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing specified carpet with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in installing carpet with minimum three years documented experience.

1.06 FIELD CONDITIONS

- A. Store materials in area of installation for minimum period of 24 hours prior to installation.
- B. Maintain minimum 70 degrees F ambient temperature 24 hours prior to, during and 24 hours after installation.
- C. Ventilate installation area during installation and for 72 hours after installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Carpet:
 - 1. Shaw Contract.
 - 2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 CARPET

- A. Carpet Type CPT-1: See Section 096813 Tile Carpetting
- B. Carpet Type CPT-2: Broadloom
 - 1. Product: 60774 Imagery manufactured by Shaw Contract.
 - 2. Roll Width: 12 ft.
 - 3. Pile Weight: 29.2oz/sq.yd. (min.)
 - 4. Color: As noted on the drawings.
 - 5. Backing: Synthetic
 - 6. Secondary Backing: Classicbac

2.03 CUSHION

- A. Cushion: Cellular rubber.
 - 1. VOC Content: Comply with Section 01 6116.

2.04 ACCESSORIES

- A. Subfloor Filler: Type recommended by carpet manufacturer.
- B. Tackless Strip: Carpet gripper, of type recommended by carpet manufacturer to suit application, with attachment devices.
- C. Moldings and Edge Strips: Embossed aluminum, silver color.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that subfloor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive carpet.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive carpet.
- C. Verify that subfloor surfaces are dust-free and free of substances that could impair bonding of adhesives to subfloor surfaces.

3.02 PREPARATION

- A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.

3.03 INSTALLATION - GENERAL

- A. Starting installation constitutes acceptance of subfloor conditions.
- B. Install carpet and cushion in accordance with manufacturer's instructions and CRI 104 (Commercial).
- C. Verify carpet match before cutting to ensure minimal variation between dye lots.
- D. Lay out carpet and locate seams in accordance with shop drawings.
 - 1. Locate seams in area of least traffic, out of areas of pivoting traffic, and parallel to main traffic.
 - 2. Do not locate seams perpendicular through door openings.
 - 3. Align run of pile in same direction as anticipated traffic and in same direction on adjacent pieces.
 - 4. Locate change of color or pattern between rooms under door centerline.
 - 5. Provide monolithic color, pattern, and texture match within any one area.
- E. Install carpet tight and flat on subfloor, well fastened at edges, with a uniform appearance.

3.04 STRETCHED-IN CARPET VERIFY WITH MANUFACTURER

- A. Install tackless strips with pins facing the wall around entire perimeter, except across door openings. Use edge strip where carpet terminates at other floor coverings.
- B. Space tackless strips slightly less than carpet thickness away from vertical surfaces, but not more than 3/8 inch.
- C. Install cushion in maximum size pieces using spot adhesive to adhere to subfloor.
- D. Lay out cushion so that seams will be perpendicular to, or offset from, minimum 6 inches from carpet seams.
- E. Butt cushion edges together and tape seams.
- F. Trim cushion tight to edge of tackless strip and around projections and contours.
- G. Double cut carpet seams, with accurate pattern match. Make cuts straight, true, and unfrayed. Apply seam adhesive to all cut edges immediately.
- H. Join seams using hot adhesive tape. Form seams straight, not overlapped or peaked, and free of gaps.
- I. Following seaming, hook carpet onto tackless strip at one edge, power stretch, and hook firmly at other edges. Follow manufacturer's recommendations for method and amount of stretch.

- J. Trim carpet neatly at walls and around interruptions. Tuck edges into space between tackless strip and wall.

3.05 CLEANING

- A. Remove excess adhesive from floor and wall surfaces without damage.
- B. Clean and vacuum carpet surfaces.

END OF SECTION

**SECTION 09 7200
WALL COVERINGS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Surface preparation and prime painting.
- B. Wall covering.

1.02 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on wall covering and adhesive.
- C. Samples: Submit two samples of wall covering, 12_by 12 inch in size illustrating color, finish, and texture.

1.03 DELIVERY, STORAGE, AND HANDLING

- A. Inspect roll materials at arrival on site, to verify acceptability.
- B. Protect packaged adhesive from temperature cycling and cold temperatures.
- C. Do not store roll goods on end.

1.04 FIELD CONDITIONS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the adhesive or wall covering product manufacturer.
- B. Maintain these conditions 24 hours before, during, and after installation of adhesive and wall covering.

PART 2 PRODUCTS

2.01 WALL COVERINGS

- A. Wall Covering - Type WC-1: Fabric-backed vinyl roll stock.
 - 1. Fire Rating: Class A per ASTM E84 (adhered)
 - 2. Total Weight: 20 oz/lin. yd.
 - 3. Roll Width: 52 inches.
 - 4. Collection: Calabria Silhouette Scilla.
 - 5. Manufacturers:
 - a. DL Couch.
- B. Adhesive: Type recommended by wall covering manufacturer to suit application to substrate.
- C. Substrate Filler: As recommended by adhesive and wall covering manufacturers; compatible with substrate.
- D. Substrate Primer and Sealer: Alkyd enamel type.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate surfaces are prime painted and ready to receive work, and comply with requirements of wall covering manufacturer.
- B. Measure moisture content of surfaces using an electronic moisture meter. Do not apply wall coverings if moisture content of substrate exceeds level recommended by wall covering manufacturer.
- C. Verify flatness tolerance of surfaces does not vary more than 1/8 inch in 10 feet nor vary at a rate greater than 1/16 inch/ft.

3.02 PREPARATION

- A. Fill cracks in substrate and smooth irregularities with filler; sand smooth.
- B. Wash impervious surfaces with tetra-sodium phosphate, rinse and neutralize; wipe dry.
- C. Surface Appurtenances: Remove or mask electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.
- D. Apply one coat of primer sealer to substrate surfaces. Allow to dry. Lightly sand smooth.
- E. Vacuum clean surfaces free of loose particles.

3.03 INSTALLATION

- A. Apply adhesive and wall covering in accordance with manufacturer's instructions.
- B. Apply adhesive to wall surface immediately prior to application of wall covering.
- C. Apply wall covering smooth, without wrinkles, gaps or overlaps. Eliminate air pockets and ensure full bond to substrate surface.
- D. Butt edges tightly.
- E. Remove excess adhesive while wet from seam before proceeding to next wall covering sheet. Wipe clean with dry cloth.

END OF SECTION

SECTION 09 9113
EXTERIOR PAINTING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Surface preparation.
- B. Field application of paints.
- C. Scope: Finish exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:
- D. Do Not Paint or Finish the Following Items:
 - 1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
 - 2. Items indicated to receive other finishes.
 - 3. Items indicated to remain unfinished.
 - 4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
 - 5. Floors, unless specifically indicated.
 - 6. Glass.
 - 7. Concealed pipes, ducts, and conduits.

1.02 REFERENCE STANDARDS

- A. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Base Materials; 2007.
- B. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition, www.paintinfo.com.
- C. SSPC-SP 1 - Solvent Cleaning; 2015.
- D. SSPC-SP 6 - Commercial Blast Cleaning; 2007.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. **All paint systems must conform to MPI.**
- C. Product Data: Provide complete list of products to be used, with the following information for each:
 - 1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
 - 2. MPI product number (e.g. MPI #47).
 - 3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.

1.04 MOCK-UP

- A. See Section 01 4000 - Quality Requirements, for general requirements for mock-up.
- B. Provide 10 LF of painted cornice detail for review.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.06 FIELD CONDITIONS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- C. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Provide paints and finishes from the same manufacturer to the greatest extent possible.
- B. Paints:
 - 1. Sherwin-Williams Company: www.sherwin-williams.com/#sle.
- C. Primer Sealers: Same manufacturer as top coats.

2.02 PAINTS AND FINISHES - GENERAL

- A. Paints and Finishes: Ready mixed, unless required to be a field-catalyzed paint.
 - 1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
 - 2. Supply each paint material in quantity required to complete entire project's work from a single production run.
 - 3. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.

2.03 PAINT SYSTEMS - EXTERIOR

- A. Paint E-OP - Exterior Surfaces to be Painted, Unless Otherwise Indicated: Including Azek Trim. **LRV for Azek trim must be 55 or greater.**
 - 1. Two top coats and one coat primer.
 - 2. Top Coat(s): Exterior Latex; MPI #10, 11, 15, 119, or 214. Semi Gloss
 - 3. Top Coat Sheen:
 - a. Semi-Gloss: MPI gloss level 5; use this sheen at all locations.
- B. Paint ME-OP-2L - Ferrous Metals, Primed, Latex, 2 Coat:
 - 1. Touch-up with rust-inhibitive primer recommended by top coat manufacturer.
 - 2. Semi-gloss: Two coats of latex enamel.

2.04 PRIMERS

- A. Primers: Provide the following unless other primer is required or recommended by manufacturer of top coats.
 - 1. Alkali Resistant Water Based Primer; MPI #3.
 - 2. Interior/Exterior Quick Dry Alkyd Primer for Metal; MPI #76.

2.05 ACCESSORY MATERIALS

- A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.
- B. Patching Material: Latex filler.
- C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.

- C. Test shop-applied primer for compatibility with subsequent cover materials.
- D. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
 - 1. Exterior Wood: 15 percent, measured in accordance with ASTM D4442.

3.02 PREPARATION

- A. Clean surfaces thoroughly and correct defects prior to application.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces for finishing.
- D. Seal surfaces that might cause bleed through or staining of topcoat.
- E. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- F. Ferrous Metal:
 - 1. Solvent clean according to SSPC-SP 1.
 - 2. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 "Commercial Blast Cleaning". Protect from corrosion until coated.
- G. Exterior Wood Surfaces to Receive Opaque Finish: Remove dust, grit, and foreign matter. Seal knots, pitch streaks, and sappy sections. Fill nail holes with tinted exterior caulking compound after prime coat has been applied. Back prime concealed surfaces before installation.

3.03 APPLICATION

- A. Exterior Wood to Receive Opaque Finish: If final painting must be delayed more than 2 weeks after installation of woodwork, apply primer within 2 weeks and final coating within 4 weeks.
- B. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".
- C. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- D. Apply each coat to uniform appearance.
- E. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- F. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 PROTECTION

- A. Protect finishes until completion of project.
- B. Touch-up damaged finishes after Substantial Completion.

END OF SECTION

SECTION 09 9123
INTERIOR PAINTING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Surface preparation.
- B. Field application of paints.
- C. Scope: Finish interior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.
 - 1. Both sides and edges of plywood backboards for electrical and telecom equipment before installing equipment.
 - 2. Mechanical and Electrical:
 - a. In finished areas, paint conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, and sprinkler lines, unless otherwise indicated.
- D. Do Not Paint or Finish the Following Items:
 - 1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
 - 2. Items indicated to receive other finishes.
 - 3. Items indicated to remain unfinished.
 - 4. Fire rating labels, equipment serial number and capacity labels, bar code labels, and operating parts of equipment.
 - 5. Floors, unless specifically indicated.
 - 6. Glass.
 - 7. Concealed pipes, ducts, and conduits.

1.02 REFERENCE STANDARDS

- A. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Base Materials; 2007.
- B. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition, www.paintinfo.com.
- C. SSPC-SP 1 - Solvent Cleaning; 2015.
- D. SSPC-SP 6 - Commercial Blast Cleaning; 2007.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide complete list of products to be used, with the following information for each:
 - 1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
 - 2. MPI product number (e.g. MPI #47).
 - 3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.

1.04 MOCK-UP

- A. See Section 01 4000 - Quality Requirements, for general requirements for mock-up.
- B. Provide panel, 6 feet long by 6 feet wide, illustrating paint color, texture, and finish at refinished floor and ceiling transparent finishes.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

- B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.06 FIELD CONDITIONS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Provide paints and finishes from the same manufacturer to the greatest extent possible.
 - 1. In the event that a single manufacturer cannot provide specified products, minor exceptions will be permitted provided approval by Architect is obtained using the specified procedures for substitutions.
 - 2. Substitution of MPI-approved products by a different manufacturer is preferred over substitution of unapproved products by the same manufacturer.
- B. Paints:
 - 1. Sherwin-Williams Company: www.sherwin-williams.com/#sle.
- C. Primer Sealers: Same manufacturer as top coats.

2.02 PAINTS AND FINISHES - GENERAL

- A. Paints and Finishes: Ready mixed, unless intended to be a field-catalyzed paint.
 - 1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
 - 2. Supply each paint material in quantity required to complete entire project's work from a single production run.
 - 3. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.

2.03 PAINT SYSTEMS - INTERIOR

- A. Paint I-OP - Interior Surfaces to be Painted, Unless Otherwise Indicated: Including gypsum board, wood, plaster, uncoated steel, shop primed steel, galvanized steel, and aluminum.
 - 1. Two top coats and one coat primer.
 - 2. Top Coat(s): High Performance Architectural Interior Latex; MPI #138, 139, 140, or 141.
 - a. Products:
 - 1) Sherwin-Williams Pre-Catalyzed Waterbased Epoxy, Eg-Shel. (MPI #139)
 - 2) Sherwin-Williams Pre-Catalyzed Waterbased Epoxy, Semi-Gloss. (MPI #141) **(at Bathroom walls and ceilings)**
- B. Paint I-OP-MD-DT - Medium Duty Door/Trim: For surfaces subject to frequent contact by occupants, including metals and wood:
 - 1. Two top coats and one coat primer.
 - 2. Top Coat(s): Interior Epoxy-Modified Latex; MPI #115 or 215.
 - a. Products:
 - 1) Sherwin-Williams Waterbased Catalyzed Epoxy, Semi-Gloss.
- C. Paint I-TR -W - Transparent Finish on Wood.
 - 1. 2 top coats, no stain.
- D. Paint I-TR-C - Transparent Finish on Concrete Floors.

1. 2 coats sealer.
2. Sealer: Water Based Sealer for Concrete Floors; MPI #99.
 - a. Products:
 - 1) PPG Paints Perma-Crete Plex-Seal WB Interior/Exterior Clear Sealer, 4-6200XI, Satin. (MPI #99)
 - 2) Substitutions: Section 01 6000 - Product Requirements.

2.04 PRIMERS

- A. Primers: Provide the following unless other primer is required or recommended by manufacturer of top coats.
 1. Interior Moisture Vapor Barrier Latex Primer Sealer; MPI 61.
 - a. Products:
 - 1) Sherwin Williams Moisture Vapor Barrier Interior Latex Primer/ Sealer.
 - 2) Substitutions: Section 01 6000 - Product Requirements.

2.05 ACCESSORY MATERIALS

- A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.
- B. Patching Material: Latex filler.
- C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.
- C. Test shop-applied primer for compatibility with subsequent cover materials.
- D. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
 1. Gypsum Wallboard: 12 percent.
 2. Plaster and Stucco: 12 percent.
 3. Interior Wood: 15 percent, measured in accordance with ASTM D4442.
 4. Concrete Floors and Traffic Surfaces: 8 percent.

3.02 PREPARATION

- A. Clean surfaces thoroughly and correct defects prior to application.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.
- D. Seal surfaces that might cause bleed through or staining of topcoat.
- E. Concrete Floors and Traffic Surfaces: Remove contamination, acid etch, and rinse floors with clear water. Verify required acid-alkali balance is achieved. Allow to dry.
- F. Gypsum Board: Fill minor defects with filler compound. Spot prime defects after repair.
- G. Plaster: Fill hairline cracks, small holes, and imperfections with latex patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high alkali surfaces.
- H. Aluminum: Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
- I. Galvanized Surfaces:

- J. Ferrous Metal:
 - 1. Solvent clean according to SSPC-SP 1.
 - 2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
 - 3. Remove rust, loose mill scale, and other foreign substances using using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 "Commercial Blast Cleaning". Protect from corrosion until coated.
- K. Wood Surfaces to Receive Opaque Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats. Back prime concealed surfaces before installation.

3.03 APPLICATION

- A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
- B. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".
- C. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- D. Apply each coat to uniform appearance in thicknesses specified by manufacturer.
- E. Sand wood and metal surfaces lightly between coats to achieve required finish.
- F. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- G. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 SCHEDULE - PAINT SYSTEMS

- A. See Schedule on Drawing ID1.01 & ID9.04

END OF SECTION

SECTION 10 1400
SIGNAGE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Cash allowance for signs.
- B. Room and door signs.
- C. Residential Unit Doors
- D. Interior directional and informational signs.
- E. Building identification signs.

1.02 PRICE AND PAYMENT PROCEDURES

- A. See Section 01 2100 - Allowances, for cash allowances affecting this section.
- B. Allowance amount covers purchase, delivery, and installation.

1.03 REFERENCE STANDARDS

- A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.
- B. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- C. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2009.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's printed product literature for each type of sign, indicating sign styles, font, foreground and background colors, locations, overall dimensions of each sign.

1.05 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

2.01 VENDOR

- A. Expose Signs & Graphics Inc.; 13 Airport Road, Hopedale MA 01747
- B. Contact: Andy Clark 1-508-351-0941

2.02 SIGNAGE APPLICATIONS

- A. 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.
- B. Room and Door Signs: Provide a sign for every doorway, whether it has a door or not, not including corridors, lobbies, and similar open areas.
 - 1. Sign Type: Flat signs with engraved panel media as specified.
 - 2. Provide "tactile" signage, with letters raised minimum 1/32 inch and Grade II braille.
 - 3. Character Height: 1 inch.
 - 4. Sign Height: 2 inches, unless otherwise indicated.
 - 5. Office Doors: Identify with room numbers to be determined later, not the numbers indicated on drawings; in addition, provide "window" section for replaceable occupant name.

6. Conference and Meeting Rooms: Identify with room numbers to be determined later, not the numbers indicated on drawings; in addition, provide "window" section with sliding "In Use/Vacant" indicator.
 7. Service Rooms: Identify with room names and numbers to be determined later, not those indicated on drawings.
 8. Rest Rooms: Identify with pictograms, the names "MEN" and "WOMEN", and braille.
 9. Interior Stair Signage: **Comply with NFPA 101; 2015 edition; Section 7.2.2.5.4.1**
- C. Building Identification Signs:
1. Use individual metal letters.
 2. Mount on outside wall in location TBD.

2.03 SIGN TYPES

- A. Flat Signs: Signage media without frame.
1. Edges: Square.
 2. Corners: Square.
 3. Wall Mounting of One-Sided Signs: Tape adhesive.
- B. Color and Font: Unless otherwise indicated:
1. Character Font: Helvetica, Arial, or other sans serif font.
 2. Character Case: Upper case only.
 3. Character Color: Black color.

2.04 TACTILE SIGNAGE MEDIA

- A. Engraved Panels: Laminated colored plastic; engraved through face to expose core as background color:
1. Total Thickness: 1/16 inch.

2.05 DIMENSIONAL LETTERS

- A. Metal Letters:
1. Metal: Aluminum casting.
 2. Letter Height: 8 inches.
 3. Text and Typeface:
 - a. Character Font: Helvetica, Arial, or other sans serif font.
 - b. Character Case: Upper case only.
 4. Mounting: Concealed screws.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install neatly, with horizontal edges level.
- C. Locate signs and mount at heights indicated on drawings and in accordance with ADA Standards and ICC A117.1.
- D. Protect from damage until Date of Substantial Completion; repair or replace damaged items.

END OF SECTION

SECTION 10 2800
TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Commercial toilet accessories.
- B. Residential toilet, shower, and bath accessories.
- C. Under-lavatory pipe supply covers.
- D. Accessories for residential bathrooms.

1.02 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
- C. ASTM B456 - Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium; 2011.
- D. ASTM C1036 - Standard Specification for Flat Glass; 2011.
- E. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror; 2008 (Reapproved 2013).

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the work with the placement of internal wall reinforcement, concealed ceiling supports, and reinforcement of toilet partitions to receive anchor attachments.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
 - 1. Grind welded joints smooth.
- B. Stainless Steel Sheet: ASTM A666, Type 304.
- C. Mirror Glass: Annealed float glass, ASTM C1036 Type I, Class 1, Quality Q2, with silvering, protective and physical characteristics complying with ASTM C1503.

2.02 FINISHES

- A. Stainless Steel: Satin finish, unless otherwise noted.
- B. Chrome/Nickel Plating: ASTM B456, SC 2, polished finish, unless otherwise noted.

2.03 COMMERCIAL TOILET ACCESSORIES

- A. Toilet Paper Dispenser: Double roll, surface mounted bracket type, stainless steel.
- B. Soap Dispenser: Liquid soap dispenser, wall-mounted, surface, with stainless steel cover and horizontal stainless steel tank and working parts; push type soap valve, check valve, and window gauge refill indicator, tumbler lock.
 - 1. Minimum Capacity: 48 ounces.
- C. Mirrors: Stainless steel framed, 1/4 inch thick annealed float glass; ASTM C1036.
 - 1. Size: 24x36.

2. Frame: 0.05 inch angle shapes, with mitered and welded and ground corners, and tamperproof hanging system; satin finish.
- D. Grab Bars: Stainless steel, nonslip grasping surface finish. **Community Room Bathrooms & ADA Units.**
 1. Standard Duty Grab Bars:
 - a. Push/Pull Point Load: 250 pound-force, minimum.
 - b. Dimensions: 1-1/4 inch outside diameter, minimum 0.05 inch wall thickness, exposed flange mounting, 1-1/2 inch clearance between wall and inside of grab bar.
 - c. Length and Configuration: As indicated on drawings.

2.04 RESIDENTIAL TOILET, SHOWER, AND BATH ACCESSORIES

- A. Medicine Cabinet: Frameless recessed wall cabinet.
 1. Manufacturer: WG Wood Products
 2. Style: FR-224 24" High FR Series Frameless in the wall cabinet.
 3. Color: White
- B. Mirrors: Beveled Edge, 1/4 inch thick annealed float glass; ASTM C1036.
 1. Size 36" x 36" (Based on vanity size)
- C. Toilet Paper Holder: Surface mounted, single roll, concealed attachment.
 1. Material: Stainless steel; bright polished finish.
 2. Products:
 - a. Manuf. / Model #Olympia 7MT032.
 - b. Color: Polished Chrome.
- D. 18" Towel Bar: Round tubular bar; rectangular mounting posts, concealed attachment.
 1. Products:
 - a. Manuf. / Model #Olympia 7MTO031.
 - b. Color: Polished Chrome.
- E. 24" Towel Bar: Round tubular bar; rectangular mounting posts, concealed attachment.
 1. Products:
 - a. Manuf. / Model #Olympia 7MTO030.
 - b. Color: Polished Chrome.
- F. Towel Ring: Post with hanging ring, concealed attachment.
 1. Products:
 - a. Manuf. / Model #Olympia 7MTO034.
 - b. Color: Polished Chrome.
- G. Shower Curtain Rod: Straight tube, 1 inch diameter, with mounting flanges for concealed attachment.
 1. Products:
 - a. Manuf. / Model #Olympia 2102-5PS & 65-F-PS.
 - b. Color: Polished Chrome.
- H. Robe Hook: Single-prong, concealed attachment.
 1. Products:
 - a. Manuf. / Model #Olympia 7MT033.
 - b. Color: Polished Chrome.

2.05 UNDER-LAVATORY PIPE AND SUPPLY COVERS

- A. Under-Lavatory Pipe and Supply Covers:
 1. Insulate exposed drainage piping, including hot, cold, and tempered water supplies under lavatories or sinks to comply with ADA Standards.
 2. Exterior Surfaces: Smooth non-absorbent, non-abrasive surfaces.
 3. Construction: 1/8 inch flexible PVC.
 4. Color: White.
 5. Fasteners: Reusable, snap-locking fasteners with no sharp or abrasive external surfaces.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify exact location of accessories for installation.

3.02 PREPARATION

- A. Deliver inserts and rough-in frames to site for timely installation.
- B. Provide templates and rough-in measurements as required.

3.03 INSTALLATION

- A. Install accessories in accordance with manufacturers' instructions in locations indicated on drawings.
- B. Install plumb and level, securely and rigidly anchored to substrate.
- C. Mounting Heights: As required by accessibility regulations, unless otherwise indicated.
- D. Mounting Heights and Locations: as indicated on drawings and as follows:

END OF SECTION

**SECTION 10 4400
FIRE PROTECTION SPECIALTIES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fire extinguishers.
- B. Fire Stop Canisters & Decorative Covers
- C. Fire extinguisher cabinets.
- D. Flammable Liquids Storage Cabinets

1.02 REFERENCE STANDARDS

- A. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Fire Stops; 2013a.
- B. NFPA 10 - Standard for Portable Fire Extinguishers; 2013.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Fire Extinguishers:
 - 1. Kidde, a unit of United Technologies Corp: www.kidde.com.
 - 2. Amerex
 - 3. Pyro-Chem, a Tyco Business: www.pyrochem.com.
 - 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Fire Stop Cannisters
 - 1. **Stove Top Fire stop; STFS Plus Model # 675-3 (2 per stove)**
 - 2. **Stove Top Firestop; Decorative cover Plus LC**

2.02 FIRE EXTINGUISHERS

- A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.
- B. Multipurpose Dry Chemical Type Fire Extinguishers: Carbon steel tank, with pressure gauge.
 - 1. Class: A:B:C type.
 - 2. Size: 5 pound.
 - 3. Finish: Baked polyester powder coat, Red color.

2.03 FIRE EXTINGUISHER CABINETS

- A. Fire Rating: Listed and labeled in accordance with ASTM E814 requirements for fire resistance rating of walls where being installed.
- B. Fire Rated Cabinet Construction: One-hour fire rated.
 - 1. Steel; double wall or outer and inner boxes with 5/8 inch thick fire barrier material.
- C. Cabinet Configuration: Semi-recessed type.

2.04 FLAMMABLE LIQUIDS STORAGE CABINETS

- A. Manufacturer: Justrite
- B. Model #: 893020 (Yellow)
- C. Capacity: 30 Gallons
- D. No. of doors: 2 self closing
- E. No. of shelves: 1

- F. Approvals: FM, NFPA 30, and NFPA 1

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Place extinguishers on wall brackets.
- C. **Install fire stop cannisters in range hood (two per stove) per manuf. instructions.**
- D. **Install STFS Plus LC Decorative cover per manufacturer's instructions.**

3.02 SCHEDULES

- A. Provide Seven (7) extinguishers at building A, Nine (9) extinguishers at building B, and Two (2) extinguishers at Community Building.

END OF SECTION

**SECTION 10 5500
POSTAL SPECIALTIES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Central mail delivery boxes.

1.02 REFERENCE STANDARDS

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's specifications and descriptive literature, installation instructions, maintenance information, and current USPS approval documentation.

1.04 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide manufacturer's warranty against defects in materials or workmanship for a period of 5 years from Date of Substantial Completion.

PART 2 PRODUCTS

2.01 CENTRAL MAIL DELIVERY BOXES

- A. Manufacturers:
 - 1. Salsbury Industries; 4C horizontal, 3800 Series: www.mailboxes.com.
- B. Central Mail Delivery Boxes: Provide products approved for United States Postal Service (USPS) delivery.
 - 1. Materials: Aluminum with stainless steel hardware.
 - 2. Finish: Powder coat in color selected by Architect from manufacturer's standard colors.
 - 3. Building A - Unit Types and Sizes: As 27 mail slots, 3 parcel slots.
 - 4. Building B - Unit Types and Sizes: As [36 mail slots, 4 parcel slots].
 - 5. Configurations: TBD

2.02 COMPONENTS

- A. Locking - Front Loading Master Door: Three-point latching mechanism with USPS master lock furnished and installed by postmaster.
- B. Locking - Customer Compartment Doors: USPS approved cam lock, 3 keys each lock.
- C. Locking - Parcel Compartment Doors: Double-lock arrangement with USPS approved cam lock for customer access, and USPS master lock furnished and installed by postmaster.
- D. Identification - Customer and Parcel Compartments: Sequential numerical or alphabetic characters, top to bottom, left to right; factory-installed.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that concrete base and anchor bolts are ready to receive pedestal-mounted units.
- B. Do not begin installation until unacceptable conditions are corrected.

3.02 INSTALLATION

- A. Install postal specialties in accordance with approved shop drawings, manufacturer's instructions, and USPS requirements.
- B. Adjust and lubricate door hardware to operate properly.

END OF SECTION

**SECTION 10 5723
CLOSET AND UTILITY SHELVING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Wall mounted wire closet shelving.
- B. Accessories.

1.02 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used, with installation instructions.

1.03 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store products under cover and elevated above grade.
- C. Store flat to prevent warpage and bending.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Wire Storage Shelving:
 - 1. ClosetMaid Corporation Total Slide Shelving at Coat and Clothes closets, Low profile linen shelving at linen closets: www.closetmaid.com.
 - 2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 SHELVING APPLICATIONS

- A. Shelf Depth: 16 inches, unless otherwise indicated.
- B. Master Bedroom Closets:
 - 1. Wall to wall shelf with free sliding hanger rod.
- C. Coat Closets:
 - 1. Wall-to-wall shelf with free sliding hanger rod.
- D. Linen Closets:
 - 1. Wall-to-wall shelves spaced at 13 inch vertically, not less than 12 inch deep. **(5 Total per Closet)**
- E. Broom Closet:
 - 1. Wall to wall shelf.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Inspect areas to receive shelving or storage system, to verify that spaces are properly prepared to receive shelf units, and are of dimensions indicated on shop drawings.
- B. Verify appropriate fastening hardware.
- C. Do not begin installation until substrates have been properly prepared.
- D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 INSTALLATION

- A. Install wire shelving in accordance with manufacturer's instructions, with shelf surfaces level.
- B. Cap exposed ends of cut wire shelving.

- C. Install wire shelving back clips, end clips at side walls, and support braces at open ends. Install intermediate support braces as recommended by manufacturer.
- D. Wire Shelving Mounting Heights:
 - 1. Single Hanging Rod Units: Install shelf at 68 inches above floor. **48" above floor at accessible units.**

3.03 CLEANING

- A. Clean soiled surfaces after installation.

END OF SECTION

**SECTION 11 3013
RESIDENTIAL APPLIANCES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Kitchen appliances.

1.02 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's data indicating dimensions, capacity, and operating features of each piece of residential equipment specified.
- C. Copies of Warranties: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.03 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide five (5) year manufacturer warranty on refrigeration system of refrigerators.
- C. Provide ten (10) year manufacturer warranty on tub and door liner of dishwashers.

PART 2 PRODUCTS

2.01 KITCHEN APPLIANCES

- A. Range at Unit Kitchens:
 - 1. Manufacturer: GE
 - 2. Model #: JBS460DMBB
 - 3. Color: Black
- B. Range at Accessible Kitchens:
 - 1. Manufacturer: GE
 - 2. Model # JB480DMBB
 - 3. Color: Black
- C. Top Freezer Refrigerator at Unit Kitchens
 - 1. Manufacturer: GE
 - 2. Model # GTE18GTNRBB
 - 3. Color: Black
 - 4. **No Ice Maker**
- D. Top Freezer Refrigerator at ADA Unit & Community Room & Group 2 Units
 - 1. Manufacturer: GE
 - 2. Model # GTE17GTNRBB
 - 3. Color: **Black-Provide Stainless Steel at Community Room**
 - 4. **No Ice Maker**
- E. Dishwasher at Unit Kitchens
 - 1. Manufacturer: GE
 - 2. Model #: GSD3300KBB
 - 3. Color: Black
- F. Dishwasher at Accessible Unit Kitchens
 - 1. Manufacturer: GE
 - 2. Model #: GDT225SGLBB
 - 3. Color: Black
- G. Microwave/Range Hood at Unit Kitchens
 - 1. Manufacturer: GE

2. Model #: JNM3163DJBB
 3. Color: Black
- H. Range Hood at Accessible Unit Kitchens
1. Manufacturer: GE
 2. Model #: JVX3300DJBB
 3. Color: Black
 4. Accessories: **Provide remote rocker switches mounted 48" a.f. adjacent to the hood for ADA access.**
- I. Garbage Disposal
1. Manufacturer: InSinkErator
 2. Model #: 3/4HP Evolution Compact
 3. Color: N/A
- J. Microwave drawer at Community Room
1. Manufacturer: Sharp
 2. Model #: KB-65424PS
 3. Color: Stainless Steel
- K. Microwave at ADA Unit
1. Manufacturer: GE
 2. Model #: PES7227DLBB
 3. Color: Black
- L. 30 " Cooktop at Group 2A Units
1. Manufacturer: GE
 2. Model #: JP3030DJBB
 3. Color: Black
- M. 30" Wall Oven at Group 2A Units
1. Manufacturer: GE
 2. Model #: JTS3000DNBB
 3. Color: Black
- N. All appliances **to be Energy Star Rated where applicable.**

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify utility rough-ins are provided and correctly located.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. **Verify refrigerator size and framing openings to permit full door opening to allow access to drawers.**
- C. **Anchor built-in equipment in place. Stove to be anchored in place to prevent tipping.**

3.03 ADJUSTING

- A. Adjust equipment to provide efficient operation.

3.04 CLEANING

- A. Remove packing materials from equipment and properly discard.
- B. Wash and clean equipment.

END OF SECTION

**SECTION 12 2113
HORIZONTAL LOUVER BLINDS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Horizontal slat louver blinds.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the placement of concealed blocking to support blinds. See Section 06 1000.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data indicating physical and dimensional characteristics.
- C. Samples: Submit two samples, 24 inch long illustrating slat materials and finish, cord type and color.
- D. Manufacturer's Installation Instructions: Indicate special procedures.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Horizontal Louver Blinds:
 - 1. Graber.

2.02 BLINDS

- A. Description: Horizontal slat louvers hung from full-width headrail with full-width bottom rail.
- B. Manual Operation: Control of raising and lowering by cord with full range locking; blade angle adjustable by control wand.
- C. Plastic Slats: Polymer composite, square slat corners.
 - 1. Width: 1 inch.
 - 2. Color: As selected by Architect.
- D. Slat Support: Woven polypropylene cord, ladder configuration.
- E. Head Rail: Pre-finished, formed aluminum box, with end caps; internally fitted with hardware, pulleys, and bearings for operation; same depth as width of slats.
- F. Bottom Rail: Pre-finished, formed steel; with end caps.
- G. Lift Cord: Braided nylon; continuous loop; complying with WCMA A100.1.
- H. Control Wand: Extruded hollow plastic; hexagonal shape.
 - 1. Length of window opening height less 3 inch.
 - 2. Color: Clear.
- I. Headrail Attachment: Wall brackets.

2.03 FABRICATION

- A. Determine sizes by field measurement.
- B. Fabricate blinds to fit within openings with uniform edge clearance of 1/2 inch.
- C. Fabricate blinds to cover window frames completely.
- D. At openings requiring multiple blind units, provide separate blind assemblies with space of 1 inch between blinds, located at window mullion centers.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install blinds in accordance with manufacturer's instructions.

3.02 ADJUSTING

- A. Adjust blinds for smooth operation.

3.03 CLEANING

- A. Clean blind surfaces just prior to occupancy.

3.04 SCHEDULE

- A. Provide Blinds at all unit windows and community building windows. No Blinds at stairwells, corridors or lobbies.

END OF SECTION

**SECTION 12 3530
RESIDENTIAL CASEWORK**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Kitchen cabinets.
- B. Kitchen countertops.
- C. Vanity cabinets.

1.02 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide component dimensions, configurations, construction details, and joint details.
- C. Certificate: Submit Kitchen Cabinet Manufacturers Association (KCMA) certificate showing conformance with KCMA A161.1.
- D. Shop Drawings: Indicate casework locations, elevations, clearances required, rough-in and anchor placement dimensions and tolerances.

1.03 QUALITY ASSURANCE

- A. **ANSI/KCMA A161.1-2012, Performance and Construction Standard for Kitchen and Vanity Cabinets and KCMA Severe Use Specifications, 2011.**

PART 2 PRODUCTS

2.01 CABINETS KB-1

- A. Manufacturers:
 - 1. Advanta.
 - 2. Substitutions: See Section 01 6000 - Product Requirements.
- B. Kitchen Cabinets: Premanufactured and factory-finished, complying with construction and testing requirements in KCMA A161.1.
- C. **Provide removable cabinets as indicated on the drawings for accessible units. Adjacent cabinets at removable to have finished ends.**
- D. Cabinet Box: Manufacturer's standard materials and construction as determined by selected product line.
- E. Breadboard: Provide as indicated on the drawings.
- F. Cabinet Doors: At Community Building
 - 1. Style: Trevant manufactured by Advanta Cabinets.
 - 2. Species: Maple.
 - 3. Color/Pattern: Baltic.
- G. Cabinet Doors: At unit kitchens
 - 1. Style: Trevant manufactured by Advanta Cabinets.
 - 2. Species: Maple.
 - 3. Color/Pattern: Double Espresso.

2.02 COUNTERTOPS

- A. PL-1 : Post formed plastic laminate over high density particle board, coved to back splash.
 - 1. Manufacturer: Wilsonart
 - 2. Color: Dove Grey
- B. SS-1 Solid Surface at Community Room
 - 1. Manufacturer: Corian

2. Color: Deep Titanium

2.03 HARDWARE

- A. HC Unit Door Drawer Pulls
 1. Manufacturer: Amerock
 2. Style: Blackrock 3-3/4" CTC Pull BP# 55276G10 Satin Nickel
- B. Typical Unit Door & Drawer Pulls
 1. Manufacturer: Liberty # 23909

2.04 FABRICATION

- A. Shop assemble casework for delivery to site in units easily handled and to permit passage through building openings.
- B. Fabricate corners and joints without gaps.
- C. Fabricate each unit to be rigid and not dependent on adjacent units for rigidity.
- D. Provide cutouts for plumbing fixtures and appliances. Prime paint contact surfaces of cut edges.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify adequacy of support framing.

3.02 INSTALLATION

- A. Install casework, components and accessories in accordance with manufacturer's instructions.
- B. Set casework items plumb and square, securely anchored to building structure.

3.03 ADJUSTING

- A. Adjust doors, drawers, hardware, and other moving or operating parts to function smoothly.

3.04 CLEANING

- A. Clean casework, countertops, shelves, and hardware. Include inside of cabinets and drawers.

END OF SECTION

SECTION 13 1010
PASSIVE RADON CONTROL SYSTEM

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Passive Radon Control System.

1.02 RELATED REQUIREMENTS

- A. Section 01 1000 - Summary: Contract descriptions, description of alterations work, work by others, future work, occupancy conditions, use of site and premises, work sequence.

1.03 REFERENCE STANDARDS

- A. ANSI/AARST-RMS-MF - Radon Mitigation Standards for Multi-Family Buildings - 2018

1.04 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

PART 2 PRODUCTS

2.01 SCOPE:

- A. Provide passive radon control system for **Building A** in accordance with the attachment following this section entitled " Passive Radon Control System for New Construction".
- B. Provide passive radon control systems for **Building B** in accordance with the attachment following this section entitled " Passive Radon Control System for New Construction".
- C. See Drawing (TBD) and attachment after this specification for installation details.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with Attached document " Passive Radon Control System for New Construction".
- B. Provide junction box with power for future fan on house electric panel.
- C. Coordinate this work with all trades.

3.02 TESTING

- A. Owner to perform the following tests prior to Occupancy:
 - 1. Radon test in each first floor unit.

3.03 ATTACHMENTS - " PASSIVE RADON CONTROL SYSTEM FOR NEW CONSTRUCTION"

END OF SECTION

SECTION 14 2112
-ELECTRIC TRACTION ELEVATORS

GENERAL

1.01 SUMMARY

- A. This section specifies electric traction elevators.
- B. Work Required
 - 1. The work required under this section consists of all labor, materials and services required for the complete installation (including operational verification) of all the equipment required for the elevator(s) as herein specified.
 - 2. All work shall be performed in a first class, safe and workmanlike manner.
 - 3. In all cases where a device or part of the equipment is herein referred to in the singular, it is intended that such reference shall apply to as many of such devices or parts as are required to make complete installation.

1.02 RELATED SECTIONS

- A. The following sections contain requirements that relate to this section and are performed by trades other than the elevator manufacturer/installer.
 - 1. Section 01 50 00 – Temporary Facilities and Controls: protection of floor openings and personnel barriers; temporary power and lighting.
 - 2. Section 03 30 00 – Cast-In-Place Concrete: elevator pit and elevator machine foundation.
 - 3. Section 04 20 00 – Unit Masonry: masonry hoistway enclosure, building-in and grouting hoistway doorframes, and grouting of sills.
 - 4. Section 05 50 00 – Metal Fabrications: pit ladder, divider beams, supports for entrances and rails, and hoisting beam at top of elevator hoistway.
 - 5. Section 23 50 00 – Heat Generation Equipment: ventilation and temperature control of elevator equipment areas.
 - 6. Section 26 05 00 – Common Work Results for Electrical:
 - 7. Main disconnects for each elevator.
 - 8. Electrical power for elevator installation and testing.
 - 9. Disconnecting device to elevator equipment prior to activation of sprinkler system.
 - 10. The installation of dedicated GFCI receptacles in the pit and overhead.
 - 11. Lighting in controller area, machine area and pit.
 - 12. Wiring for telephone service to controller.
 - 13. Section 27 30 00 – Voice Communications: ADAAG-required emergency communications equipment.
 - 14. Section 28 31 00 – Fire Alarm Systems: fire and smoke detectors at required locations and interconnecting devices; fire alarm signal lines to contacts in the machine area.
 - 15. Section 31 10 00 – Site Clearing: excavation for elevator pit.

1.03 REFERENCES

- A. Comply with applicable building and elevator codes at the project site, including but not limited to the following:
- B. ASME A17.1/CSA B44, Safety Code for Elevators and Escalators.
- C. ASME A17.7/CSA B44, Performance-Based Safety Code for Elevators and Escalators.
- D. ADAAG, American Disabilities Act Accessibility Guidelines.
- E. ANSI A117.1, Building and Facilities, Providing Accessibility and Usability for Physically Handicapped People.
- F. ANSI/NFPA 70, (NEC) National Electrical Code.
- G. CAN/CSA C22.1, (CEC) Canadian Electrical Code.

- H. ANSI/UL 10B, Standard for Fire Test of Door Assemblies.
- I. CAN/ULC-S104-10, Standard Method for Fire Test of Door Assemblies.
- J. ANSI/NFPA 80, Standard for Fire Doors and Other Opening Protectives.
- K. Building Codes IBC or NBCC.
- L. All Local Jurisdictional applicable codes.

1.04 SYSTEM DESCRIPTION FOR BUILDING A- UNIT 1

- A. Equipment Description: Gen2® gearless elevator where the controller resides in a machine room.
- B. Equipment Control: Elevonic® Control System.
- C. Drive: Regenerative
- D. Quantity of Elevators: 1 of 1
- E. Elevator Stop Designations: 1, 2, 3
- F. Stops: 3
- G. Openings: In-Line
- H. Travel: 20 ft 6 in 0
- I. Rated Capacity: 3500 lbs. (1588 kg)
- J. Rated Speed: 200 fpm (1.02 mps)
- K. Platform Size: 6'-6 3/4" W x 6'-1 1/8" D
- L. Clear Inside Dimensions: 6'-5 9/16" W x 5'-5 9/16" D
- M. Cab Height: 7'-9" (2362 mm)
- N. Clear Cab Height: 7'-8 11/16" (2354 mm)
- O. Entrance Type and Width: Single-Slide Door- 42" (1067 mm)
- P. Entrance Height: 7'-0" (2134 mm)
- Q. Main Power Supply: 208 volts \pm 5% of normal, three-phase, with a separate equipment grounding conductor.
- R. Car Lighting Power Supply: 120 volts, single-phase, 15 amps, 60 Hz.
- S. Machine Location: Inside and at the top of the hoistway.
- T. Signal Fixtures: Manufacturer's standard with metal button targets (Excluding CA).
- U. Controller Location: In a machine room.
- V. Performance:
 - 1. Car Speed: \pm 3 % of contract speed under any loading condition or direction of travel.
 - 2. Car Capacity: Safely lower, stop and hold up to 120% of rated load (code required).
 - 3. Ride Quality:
 - a. Vertical Vibration (maximum): 20 milli-g
 - b. Horizontal Vibration (maximum): 12 milli-g
 - c. Vertical Jerk (maximum): 4.59 \pm 1.0 ft./ sec³ (1.4 \pm 0.3 m/ sec³)
 - d. Acceleration/Deceleration (maximum): 2.62 ft./ sec² (0.8 m/ sec²)
 - e. In Car Noise: 55 – 60 dB(A)
 - f. Stopping Accuracy: \pm 0.375 in. (\pm 10 mm) max, \pm 0.25 in. (\pm 6 mm) Typical
 - g. Re-leveling Distance: \pm 0.5 in. (\pm 12 mm)
- W. Operation: Simplex Collective: Using a microprocessor-based controller, operation shall be automatic by means of the car and hall buttons. If all calls in the system have been answered, the car shall park at the last landing served.
- X. Operation Features

1. Full Collective Operation
 2. Anti-nuisance
 3. Fan and Light Protection
 4. Load Weighing Bypass
 5. Independent Service
 6. Firefighters' Service Phase I and Phase II
 7. Top of Car Inspection
 8. Zoned Access at Bottom Landing
 9. Zoned Access at Upper Landing
 10. Car Secure Access
 11. Automatic Rescue Operation.
- Y. Door Control Features:
1. Door control to open doors automatically when car arrives at a landing in response to a normal hall or car call.
 2. Elevator doors shall be provided with a reopening device that will stop and reopen the car door(s) and hoistway door(s) automatically should the door(s) become obstructed by an object or person.
 3. Door protection shall consist of a two dimensional, multi-beam array projecting across the car door opening.
 4. Door nudging operation to occur if doors are prevented from closing for an adjustable period of time.
- Z. Seismic conditions do not exist.

1.05 SYSTEM DESCRIPTION FOR BUILDING B- UNIT 1

- A. Equipment Description: Gen2® gearless elevator where the controller resides in a machine room.
- B. Equipment Control: Elevonic® Control System.
- C. Drive: Regenerative
- D. Quantity of Elevators: 1 of 1
- E. Elevator Stop Designations: 1, 2, 3, 4
- F. Stops: 4
- G. Openings: In-Line
- H. Travel: 30 ft 9 in 0
- I. Rated Capacity: 3500 lbs. (1588 kg)
- J. Rated Speed: 200 fpm (1.02 mps)
- K. Platform Size: 6'-6 3/4" W x 6'-1 1/8" D
- L. Clear Inside Dimensions: 6'-5 9/16" W x 5'-5 9/16" D
- M. Cab Height: 7'-9" (2362 mm)
- N. Clear Cab Height: 7'-8 11/16" (2354 mm)
- O. Entrance Type and Width: Single-Slide Door- 42" (1067 mm)
- P. Entrance Height: 7'-0" (2134 mm)
- Q. Main Power Supply: 208 volts ± 5% of normal, three-phase, with a separate equipment grounding conductor.
- R. Car Lighting Power Supply: 120 volts, single-phase, 15 amps, 60 Hz.
- S. Machine Location: Inside and at the top of the hoistway.
- T. Signal Fixtures: Manufacturer's standard with metal button targets (Excluding CA).

- U. Controller Location: In a machine room.
- V. Performance:
 - 1. Car Speed: $\pm 3\%$ of contract speed under any loading condition or direction of travel.
 - 2. Car Capacity: Safely lower, stop and hold up to 120% of rated load (code required).
 - 3. Ride Quality:
 - a. Vertical Vibration (maximum): 20 milli-g
 - b. Horizontal Vibration (maximum): 12 milli-g
 - c. Vertical Jerk (maximum): 4.59 ± 1.0 ft./ sec³ (1.4 ± 0.3 m/ sec³)
 - d. Acceleration/Deceleration (maximum): 2.62 ft./ sec² (0.8 m/ sec²)
 - e. In Car Noise: 55 – 60 dB(A)
 - f. Stopping Accuracy: ± 0.375 in. (± 10 mm) max, ± 0.25 in. (± 6 mm) Typical
 - g. Re-leveling Distance: ± 0.5 in. (± 12 mm)
- W. Operation: Simplex Collective: Using a microprocessor-based controller, operation shall be automatic by means of the car and hall buttons. If all calls in the system have been answered, the car shall park at the last landing served.
- X. Operation Features
 - 1. Full Collective Operation
 - 2. Anti-nuisance
 - 3. Fan and Light Protection
 - 4. Load Weighing Bypass
 - 5. Independent Service
 - 6. Firefighters' Service Phase I and Phase II
 - 7. Top of Car Inspection
 - 8. Zoned Access at Bottom Landing
 - 9. Zoned Access at Upper Landing
 - 10. Car Secure Access
 - 11. Automatic Rescue Operation.
- Y. Door Control Features:
 - 1. Door control to open doors automatically when car arrives at a landing in response to a normal hall or car call.
 - 2. Elevator doors shall be provided with a reopening device that will stop and reopen the car door(s) and hoistway door(s) automatically should the door(s) become obstructed by an object or person.
 - 3. Door protection shall consist of a two dimensional, multi-beam array projecting across the car door opening.
 - 4. Door nudging operation to occur if doors are prevented from closing for an adjustable period of time.
- Z. Seismic conditions do not exist.

1.06 SUBMITTALS

- A. Product Data: Submit manufacturer's product data for each system proposed for use. Include the following:
 - 1. Signal and operating fixtures, operating panels and indicators.
 - 2. Cab design, dimensions and layout.
 - 3. Hoistway-door and frame details.
 - 4. Electrical characteristics and connection requirements.
 - 5. Expected heat dissipation of elevator equipment in hoistway (BTU).
 - 6. Color selection chart for Cab and Entrances.
- B. Shop Drawings: Submit approval layout drawings. Include the following:
 - 1. Car, guide rails, buffers, and other components in hoistway.
 - 2. Maximum rail bracket spacing.
 - 3. Maximum loads imposed on guide rails requiring load transfer to building structure.

4. Clearances and travel of car.
 5. Clear inside hoistway and pit dimensions.
 6. Location and sizes of access doors, hoistway entrances and frames.
- C. Operations and Maintenance Manuals: Provide manufacturer's standard operations and maintenance manual.

1.07 QUALITY ASSURANCE

- A. Manufacturer: Elevator manufacturer shall be ISO 9001 certified.
- B. Manufacturer shall have a minimum of fifteen years of experience in the fabrication, installation and service of elevators.
- C. Installer: Elevators shall be installed by the manufacturer.
- D. Permits, Inspections and Certificates: The Elevator Contractor shall obtain and pay for necessary Municipal or State Inspection and permit as required by the elevator inspection authority, and make such tests as are called for by the regulations of such authorities. These tests shall be made in the presence of such authorities or their authorized representatives.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Should the building or the site not be prepared to receive the elevator equipment at the agreed upon date, the General Contractor will be responsible to provide a proper and suitable storage area on or off the premises.
- B. Should the storage area be off-site and the equipment not yet delivered, then the elevator contractor, upon notification from the General Contractor, will divert the elevator equipment to the storage area. If the equipment has already been delivered to the site, then the General Contractor shall transport the elevator equipment to the storage area. The cost of elevator equipment taken to storage by either party, storage and redelivery to the job site shall not be at the expense of the elevator contractor.

1.09 SUBMITTALS

- A. Product Data: Submit manufacturer's product data for each system proposed for use. Include the following:
 1. Signal and operating fixtures, operating panels and indicators.
 2. Cab design, dimensions and layout.
 3. Hoistway-door and frame details.
 4. Electrical characteristics and connection requirements.
 5. Expected heat dissipation of elevator equipment in hoistway (BTU).
 6. Color selection chart for Cab and Entrances.
- B. Shop Drawings: Submit approval layout drawings. Include the following:
 1. Car, guide rails, buffers, and other components in hoistway.
 2. Maximum rail bracket spacing.
 3. Maximum loads imposed on guide rails requiring load transfer to building structure.
 4. Clearances and travel of car.
 5. Clear inside hoistway and pit dimensions.
 6. Location and sizes of access doors, hoistway entrances and frames.
- C. Operations and Maintenance Manuals: Provide manufacturer's standard operations and maintenance manual.

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1.12 WARRANTY

- A. The elevator contractor's acceptance is conditional on the understanding that their warranty covers defective material and workmanship. The warranty period shall not extend longer than one (1) year from the date of completion or acceptance thereof by beneficial use, whichever is earlier, of each elevator. The warranty excludes: ordinary wear and tear, improper use, vandalism, abuse, misuse, or neglect or any other causes beyond the control of the elevator contractor and this express warranty is in lieu of all other warranties, express or implied, including any warranty of merchantability or fitness for a particular purpose.

1.13 MAINTENANCE AND SERVICE

- A. Maintenance service consisting of regular examinations and adjustments of the elevator equipment shall be provided by the elevator contractor for a period of 12 months after the elevator has been turned over for the customer's use. This service shall not be subcontracted but shall be performed by the elevator contractor. All work shall be performed by competent employees during regular working hours of regular working days. This service shall not cover adjustments, repairs or replacement of parts due to negligence, misuse, abuse or accidents caused by persons other than the elevator contractor. Only genuine parts and supplies as used in the manufacture and installation of the original equipment shall be provided.
- B. The periodic lubrication of elevator components shall not be required, including: Sheaves, Rails, Belts, Ropes, Car and CWT guides, etc.
- C. The elevator control system must:
 - 1. Provide in the controller the necessary devices to run the elevator on inspection operation.
 - 2. Provide on top of the car the necessary devices to run the elevator in inspection operation.
 - 3. Provide in the controller an emergency stop switch. This emergency stop switch when opened disconnects power from the brake and prevents the motor from running.
 - 4. Provide in the event of a power outage, means from the controller to electrically lift and control the elevator brake to safely bring the elevator to the nearest available landing.
 - 5. Provide the means from the controller to reset the governor over speed switch and also trip the governor.
 - 6. Provide the means from the controller to reset the emergency brake when set because of an unintended car movement or ascending car over speed.
 - 7. (Optional) Provide the means from the controller to reset elevator earthquake operation.
- D. Provide system capabilities to enable a remote expert to create a live, interactive connection with the elevator system to enable the following functions:
 - 1. Remotely diagnose elevator issues with a remote team of experts
 - 2. Remotely return an elevator to service
 - 3. Provide real-time status updates via email
 - 4. Remotely make changes to selected elevator functions including:

- a. Control building traffic: Restrict floor access, remove car from group operation, shut down elevator, select up peak/down peak mode and activate independent service.
- b. Conserve energy: Activate cab light energy save mode, activate fan energy save mode, shut down car(s).
- c. Improve passenger experience: Extend door open times, change parking floor, activate auto car full, activate anti-nuisance, advance door opening, door nudging, extend specific floor extended opening time, release trapped passengers.

1.14 P2 PRODUCTS

1.15 MANUFACTURER

- A. Manufacturer: Design based upon Otis Elevator's Gen2™ machine room-less elevator system.

1.16 DESIGN AND SPECIFICATIONS

- A. Provide Gen2™ traction passenger elevators from Otis Elevator Company. The control system and car design based on materials and systems manufactured by Otis Elevator Company. Specifically, the system shall consist of the following components:
 1. Controller located in a machine room.
 2. An AC gearless machine using embedded permanent magnets mounted at the top of the hoistway.
 3. Polyurethane Coated-Steel Belts for elevator hoisting purposes.
 4. Regenerative drive that captures normally wasted energy and feeds clean power back into the building's power grid.
 5. LED lighting standard in ceiling lights and elevator fixtures.
 6. Sleep mode operation for LED ceiling lights and car fan.
- B. Approved Installer: Otis Elevator Company

1.17 EQUIPMENT: CONTROLLER COMPONENTS

- A. Controller: A microcomputer based control system shall be provided to perform all of the functions of safe elevator operation. The system shall also perform car and group operational control.
 1. All high voltage (110V or above) contact points inside the controller shall be protected from accidental contact when the controller doors are open.
 2. Controller shall be separated into two distinct halves; Motor Drive side and Control side. High voltage motor power conductors shall be routed so as to be physically segregated from the rest of the controller.
 3. Field conductor terminations points shall be segregated; high voltage (>30 volts DC and 110 VAC,) and low voltage (< 30 volts DC)
 4. Controllers shall be designed and tested for Electromagnetic Interference (EMI) immunity according to the EN 12016 (May 1998): "EMC Product Family Standards for lifts, escalators, and passenger conveyors Part 2 – immunity"
 5. Controller located inside a control room.
 6. Drive: A Variable Voltage Variable Frequency AC drive system shall be provided. The drive shall be set up for regeneration of AC power back to the building grid.

1.18 EQUIPMENT: HOISTWAY COMPONENTS

- A. Machine: AC gearless machine, with a synchronous permanent-magnet motor, dual solenoid service and emergency disc brakes, mounted at the top of the hoistway.
- B. Governor: The governor shall be a tension type car-mounted governor.
- C. Buffers, Car, and Counterweight: Polyurethane type buffers shall be used for speeds of 150 and 200 feet per minute. Oil buffers shall be used for a speed of 350 feet per minute.
- D. Hoistway Operating Devices:
 1. Emergency stop switch in the pit.

2. Terminal stopping switches.
- E. Positioning System: Consists of an encoder, reader box, and door zone vanes.
- F. Guide Rails and Attachments: Guide rails shall be Tee-section steel rails with brackets and fasteners. Side counterweight arrangements shall have a dual-purpose bracket that combines both counterweight guide rails, and one of the car guide rails to building fastening.
- G. Coated-Steel Belts: Polyurethane coated belts with high-tensile-grade, zinc-plated steel cords and a flat profile on the running surface and the backside of the belt. The belts shall have an FT-1 rating as referenced by NFPA 13. All driving sheaves and deflector sheaves should have a crowned profile to ensure center tracking of the belts. A continuous 24/7 monitoring system using resistance based technology has to be installed to continuously monitor the integrity of the coated-steel belts and provide advanced notice of belt wear.
- H. Governor Rope: The Governor rope shall be steel and shall consist of at least eight strands wound about a sisal core center.
- I. Fascia: Galvanized sheet steel shall be provided at the front of the hoistway.
- J. Hoistway Entrances:
 1. Frames: Entrance frames shall be of bolted construction for complete one-piece unit assembly. All frames shall be securely fastened to fixing angles mounted in the hoistway and shall be of UL fire rated steel.
 2. Sills Shall Be:
 - a. Building A - Unit 1- Extruded Aluminum Sills at: 1, 2, 3
 - b. Building B - Unit 1- Extruded Aluminum Sills at: 1, 2, 3, 4
 3. Doors: Entrance doors shall be of metal construction with vertical channel reinforcements.
 4. Fire Rating: Entrance and doors shall be UL fire rated for 1-1/2 hour
 5. Frame and Entrance Finishes:
 - a. Building A - Unit 1
 - 1) Brushed Stainless Steel Frames and Entrances at: 1, 2, 3
 - b. Building B - Unit 1
 - 1) Brushed Stainless Steel Frames and Entrances at: 1, 2, 3, 4
 6. Entrance Marking Plates: Entrance jambs shall be marked with 4" x 4" (102 mm x 102 mm) plates having raised floor markings with Braille located adjacent to the floor marking. Marking plates shall be provided on both sides of the entrance.
 7. Sight Guards: Sight guards will be furnished with all doors painted to match with painted doors, painted black for stainless steel doors.

1.19 EQUIPMENT: CAR COMPONENTS

- A. Car Frame and Safety: A car frame fabricated from formed or structural steel members shall be provided with adequate bracing to support the platform and car enclosures. The car safety shall be integral to the car frame and shall be Type "B", flexible guide clamp type.
- B. Cab:
 1. Building A - Unit 1- Premium, Steel Shell Cab with raised *lamine wall panels
 2. Building B - Unit 1- Premium, Steel Shell Cab with raised *lamine wall panels
 - a. *Lamine to be selected from manufacturer's catalog of choices.
 - b. Brushed Stainless Steel finished base plate located at top and bottom.
 - c. Brushed Stainless Steel finished vertical trim pieces are optional.
- C. Car Front Finish: Satin Stainless Steel.
- D. Car Door Finish: Satin Stainless Steel.
- E. Ceiling Type:
 1. Building A - Unit 1- Flat Ceiling with 4 LED Lights
 2. Building B - Unit 1- Flat Ceiling with 4 LED Lights
- F. Ceiling Finish:
 1. Building A - Unit 1- Brushed Steel Finish

2. Building B - Unit 1- Brushed Steel Finish
- G. Fan: A two-speed 120 VAC fan will be mounted to the ceiling to facilitate in-car air circulation, meeting A17.1 code requirements. The fan shall be rubber mounted to prevent the transmission of structural vibration and will include a baffle to diffuse audible noise. A switch shall be provided in the car-operating panel to control the fan. A variable speed fan will be available when Glassback cab option is selected.
- H. Handrail:
 1. Building A - Unit 1
 - a. 3/8" x 2" (9.5 mm x 51 mm) Flat Tubular Bars with Brushed Steel Finished handrails shall be provided on the side and rear walls
 - b. Building B - Unit 1
 - 1) 3/8" x 2" (9.5 mm x 51 mm) Flat Tubular Bars with Brushed Steel Finished handrails shall be provided on the side and rear walls
- I. Threshold:
 1. Building A - Unit 1- Extruded Aluminum
 2. Building B - Unit 1- Extruded Aluminum
- J. Emergency Exit Contact: An electrical contact shall be provided on the car-top exit.
- K. Guides: The car shall have 3" diameter roller guides at top and bottom and the counterweight shall have slide type guides at the top and the bottom. Optional counterweight guides available.
- L. Platform: The car platform shall be constructed of metal. Load weighing device shall be mounted on the belts at the top of the hoistway.
- M. The LED ceiling lights and the fan should automatically shut off when the system is not in use and be powered back up after a passenger calls the elevator and pushes a hall button.
- N. Certificate frame:
 1. Building A - Unit 1- Provide a Certificate frame with a satin stainless steel finish.
 2. Building B - Unit 1- Provide a Certificate frame with a satin stainless steel finish.

1.20 EQUIPMENT: SIGNAL DEVICES AND FIXTURES

- A. Car Operating Panel: A car operating panel shall be provided which contains all push buttons, key switches, and message indicators for elevator operation. The car operating panel shall have a satin stainless steel finish. (An optional Luxury Swing COP is available. A second COP is available)
 1. A car operating panel shall be furnished. It shall contain a bank of round stainless steel, mechanical LED illuminated buttons. Flush mounted to the panel and marked to correspond to the landings served. All buttons to have raised numerals and Braille markings. The buttons shall be:
 - a. Building A - Unit 1- Lexan 1/8" (3mm) projecting buttons, fully illuminated by a white LED.
 - b. Building B - Unit 1- Lexan 1/8" (3mm) projecting buttons, fully illuminated by a white LED.
 2. The car operating panel shall be equipped with the following features:
 - a. Raised markings and Braille to the left hand side of each push-button.
 - b. Car Position Indicator at the top of and integral to the car operating panel.
 - c. Door open and door close buttons.
 - d. Inspection key-switch.
 - e. Elevator Data Plate marked with elevator capacity and car number.
 - f. Help Button: The help button shall initiate two-way communication between the car and a location inside the building, switching over to another location if the call is unanswered, where personnel are available who can take the appropriate action. Visual indicators are provided for call initiation and call acknowledgement.

- g. Landing Passing Signal: A chime bell shall sound in the car to signal that the car is either stopping at or passing a floor served by the elevator. Car Position Indicator is at the top of and integral to the car operating panel.
 - h. In car stop switch (toggle or key unless local code prohibits use)
 - i. Firefighter's hat
 - j. Firefighter's Phase II Key-switch
 - k. Call Cancel Button
 - l. Firefighter's Phase II Emergency In-Car Operating Instructions: worded according to A17.1 2000, Article 2.27.7.2. - Optional
 - m. Please Exit Symbol: provided with emergency hospital service, Seismic Zones =2 or express priority in the hall. - Optional
- B. Car Position Indicator: A digital, LED car position indicator shall be integral to the car operating panel.
- C. Hall Fixtures: Hall fixtures shall be provided with necessary push buttons and key switches for elevator operation. All Hall fixtures shall have a Brushed Stainless Steel Finish.
- 1. Integral Hall fixtures shall feature round stainless steel, mechanical buttons marked to correspond to the landings. Hall fixtures to be located in the entrance frame face or the wall. Buttons shall be in vertically mounted fixture. Fixture shall be satin stainless steel finish.
 - 2. Hall Buttons:
 - a. Building A - Unit 1- Flat Flush Mounted satin stainless steel button with blue or white LED illuminating halo
 - b. Building B - Unit 1- Flat Flush Mounted satin stainless steel button with blue or white LED illuminating halo
- D. Car Lantern and Chime: A directional lantern visible from the corridor shall be provided in the car entrance. When the car stops and the doors are opening, the lantern shall indicate the direction in which the car is to travel and a chime will sound.
- E. Hall Position Indicators at:
- 1. Building A - Unit 1- 1
 - 2. Building B - Unit 1- 1
- F. Access key-switch at top floor in entrance jamb.
- G. Access key-switch at lowest floor in entrance jamb.

1.21 P3 EXECUTION

1.22 PREPARATION

- A. Take field dimensions and examine conditions of substrates, supports, and other conditions under which this work is to be performed. Do not proceed with work until unsatisfactory conditions are corrected.

1.23 INSTALLATION

- A. Installation of all elevator components except as specifically provided for elsewhere by others.

1.24 DEMONSTRATION

- A. The elevator contractor shall make a final check of each elevator operation with the Owner or Owner's representative present prior to turning each elevator over for use. The elevator contractor shall determine that control systems and operating devices are functioning properly.

END OF SECTION

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DIVISION 23 – MECHANICAL

**SECTION 23 00 00
MECHANICAL GENERAL REQUIREMENTS**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings, provisions of the Contract, and Division 01 Specification Sections, apply fully to work in this section.
- B. All requirements of this Section shall govern the work under all of the Sections of Division 23 - Mechanical including:

Section 23 00 50	MECHANICAL: ELECTRICAL COMPONENTS
Section 23 01 50	MECHANICAL: VIBRATION ISOLATION
Section 23 02 50	MECHANICAL: PIPE HANGERS AND SUPPORTS
Section 23 03 00	MECHANICAL: FIRE SAFING / FIRESTOPPING
Section 23 04 00	MECHANICAL: INSULATION
Section 23 04 40	MECHANICAL: PIPE CLEANING TESTING
Section 23 10 00	PLUMBING
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Section 23 56 50	HVAC: REFRIGERANT SYSTEMS
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Section 23 90 00	HVAC: CONTROL SYSTEM
Section 23 94 00	HVAC: CONTROL SEQUENCE OF OPERATION
Section 23 95 00	HVAC: TESTING ADJUSTING BALANCING
Section 23 99 00	HVAC: COMMISSIONING

1.02 DEFINITIONS:

- A. The term "Mechanical" applies and refers to all work specified within Division 23 and as indicated on the Contract Drawings.
- B. The term "Mechanical Contractor(s)" applies and refers to all those furnishing labor and materials for the completion of the work specified within Division 23 and as indicated on the Contract Drawings. All subcontractors and sub-subcontractors, as defined within the General Conditions, are collectively termed "Mechanical Contractor(s)". The requirements of Section 23 00 00 apply to all Mechanical Contractor(s).
- C. The term "this Section" shall mean "this Section of the Specifications". The term "this Division" shall refer to "Division 23 - Mechanical" and all of its Sections.
- D. Wherever the word "provide" is used, it shall mean "furnish and install complete and ready for use".
- E. "Concealed" shall mean hidden from sight in trenches, chases, furred spaces, shafts, above hung ceilings, embedded in construction, in attic spaces or in crawl spaces.
- F. "Work by others" shall mean "not by Mechanical Contractor but provided or installed by the General Contractor or any other sub-contractor performing their respective work within this contract".

1.03 INTENT:

- A. The intention of these Specifications and Drawings is to call for finished work, tested and ready for operation.
- B. The drawings are diagrammatic and not intended to show every pipe, offset, associated equipment or other minor detail. Provide such parts, materials, and appliances as required to complete the systems for operation.
- C. Equipment and/or materials specified in the singular shall be provided in quantities as required for complete systems.

1.04 PROJECT MEETINGS:

- A. Provide knowledgeable personnel to attend meetings scheduled (Include all trades) as required.

1.05 COORDINATION / COOPERATION:

- A. Cooperate with all other tradesmen, Contractors and Subcontractors to facilitate the completion of the work as a whole, as indicated on the drawings and specifications.
- B. Wherever work interconnects with the work of other Contractors, coordinate the work with these Contractors to insure that all information is available such that all equipment and material may be installed properly with all necessary connections and appurtenances.

- C. Coordinate the location of all openings required for apparatus and transmit this information sufficiently in advance, so that all openings in walls, slabs, roofs, piping supports, inserts and equipment including sleeves and access doors may be properly installed.
- D. Where work will be installed in close proximity to, or interfere with the work of other trades, assist in coordinating space conditions to a satisfactory adjustment. If directed by the Architect, provide composite working drawings indicating the proposed adjustment.
- E. All distribution systems which require pitch or slope such as plumbing drains, sprinkler piping, and condensate drain piping shall have the right of way over those systems which do not require pitch. Where the work to be installed is located by detail and or elevation, that work shall have the right of way over items indicated as schematic or without indicated location (electrical conduits, control conduits etc). Confer, coordinate and cooperate with other trades as to the location of pipes, lights, and apparatus and install all work to avoid conflict and interference.
- F. Work that is installed to interfere with the work of others prior to proper coordination and cooperation, shall be adjusted to correct the situation without extra compensation.

1.06 DELAYS:

- A. Become fully informed as to availability dates of materials and equipment to be provided. Where availability dates interfere with the progress of the work or the Sequence of Operations, notify the Architect and transmit all recommendations, including any changes in costs, to remedy the situation.
- B. Final decisions as to the procedure in cases of delays, strikes, and acts of God shall be in writing by the Architect. DO NOT alter work, materials or equipment without written authority by the Architect.
- C. Order equipment and materials in advance of the time of installation to avoid project delays.

1.07 WORKMANSHIP:

- A. Workmanship shall be of the highest quality, in the best practice of the trade, and none but competent mechanics skilled in their respective trades shall be employed. Materials and apparatus shall be provided, delivered, erected, connected, and finished in every detail; and shall be so selected and arranged as to fit properly into building spaces.

1.08 DRAWINGS:

- A. Refer to all Contract Drawings for a full comprehension of the extent and detail of the work. Drawings are supplementary to the specification and work indicated, mentioned or implied in either is considered as specified by both.
- B. Work indicated on the drawings is intended to be approximately correct to scale, but dimensions and details are to assume precedence.
- C. Typical details apply to every like item. They are not repeated in full on all of the drawings, which are diagrammatic only, but with the intention that such typical details are fully applicable.

1.09 INTERPRETATION OF PLANS AND SPECIFICATIONS:

- A. The Architect, whose interpretation shall be final, conclusive and binding on all parties, shall decide questions or disagreements as to the true intent of this specification and drawings.

1.10 CODES, ORDINANCES, AGENCIES:

- A. The State Building Code, Fire Code and local ordinances, with all amendments to date, are hereby made a part of these specifications. Work shall conform to State Codes and Regulations.
- B. The codes and ordinances shall be considered as a minimum requirement, and work specified or indicated on the drawings in excess of code requirements shall be provided.
- C. Notify authorities and agencies; obtain all permits; obtain all official licenses and certificates; obtain all necessary approvals of authorities having jurisdiction; file all necessary plans; perform all necessary testing; and transmit to the Architect all certificates of inspection.
- D. Materials provided and work installed shall comply with the National Fire Codes of the NFPA; with the requirements of local utility companies; and with the requirements of agencies having jurisdiction.
- E. Electrical materials and equipment shall be U.L. approved or listed. All electrical equipment shall be in compliance with the Energy Conservation Code and shall meet or exceed all operating energy efficiency requirements.

1.11 FEES, PERMITS:

- A. Include the following costs within the bid amount;

The payment of all fees in connection with obtaining necessary permits, licenses, and inspections.

Note: All contractors and subcontractors must file for permits

The costs of all utility connections and extensions, to include the purchasing of meter(s) and appurtenances.

The payment of applicable taxes.

1.12 PARTICIPATION IN SYSTEMS COMMISSIONING:

- A. The Contractor and Sub-Contractors shall complete all phases of work so the system can be started, tested, balanced, and otherwise commissioned.
- B. The Contractor and Sub-Contractors have primary start-up responsibilities with obligations to complete systems, including all sub-systems so they are functional. This includes the complete installation of all equipment, materials, pipe, duct, wire, insulation, controls, etc. per the contract documents and related directives, clarifications, change orders, etc.
- C. The Contractor and Sub-Contractors shall provide skilled technicians to start-up and debug all systems within the division of work. These same technicians shall be made available to assist the Commissioning Agent in completing the commissioning program as it relates to each system and

their technical specialty. Work schedules, time required for testing, etc. will be requested by the Commissioning Agent and coordinated by the Contractor and Sub-Contractors. The Contractor and Sub-Contractors will ensure the qualified technician(s) are available and present during the agreed upon schedules and of sufficient duration to complete the necessary tests, adjustment, and/or problem resolutions.

- D. Each contractor shall bear the responsibility for all costs associated with the commissioning of the components and systems which they install.
- E. Each contractor shall be responsible for all costs associated with commissioning of the components and systems which are not accepted by the Commissioning Agent. These cost shall include the fees for the Commissioning Agent and other contractors to be re-involved in the re-test.

1.13 PARTICIPATION IN NSTAR PROJECT CERTIFICATION

- A. All contractors shall review NSTAR certification specifications within Division 1.
- B. Provide submittal data required for the certification process as required for NSTAR credits.
- C. All contractors shall review and become familiar with the requirements for documentation and materials limitations based upon the NSTAR project certification process.

1.14 PARTICIPATION IN PASSIVE HOUSE PROJECT CERTIFICATION

- A. All contractors shall review PASSIVE HOUSE certification specifications within Division 1.
- B. Provide submittal data required for the certification process as required for Passive House Certification.
- C. All contractors shall review and become familiar with the requirements for documentation and materials limitations based upon the PASSIVE HOUSE project certification process.

PART 2 - SUBMITTAL GENERAL REQUIREMENTS

2.01 SUBSTITUTIONS, CONTRACTOR'S OPTIONS:

- A. See Supplementary Conditions of the Contract for Construction.
- B. Where only one product is specified, and the intention is to match existing equipment or materials within the mechanical system, the contractor shall submit his base bid on the product specified.
- C. Where only one product is specified, but is followed by the phrase "or approved equal" the Mechanical Contractor(s) must submit his base bid on the product specified. Proposed substitutions for equivalent products shall be submitted for review under SUBSTITUTION PROPOSALS.
- D. Where two or more products are specified for one use, the Mechanical Contractor(s) shall select from those products mentioned. Where specific model of one manufacturer is specified and other manufacturers are listed, the products of listed manufacturers must be equal in all major respect.

It remains the responsibility of the Mechanical Contractor to review the dimensions, weights, required clearances, required supporting structure, etc. of the equipment of "other" manufacturer's relative to the proposed use. The Mechanical Contractor is responsible for any changes to the design and to the building fabric (i.e. supporting structure, mechanical spaces, piping or ductwork connections and routing, etc.) resulting from the use of equipment of the "other" manufacturers.

No proposal for extra charges resulting from the use of equipment of the "other" manufacturers will be entertained for approval.

- E. Where products are specified by reference standard, select any product that meets the standards by any reputable manufacturer.

2.02 SUBSTITUTION PROPOSALS:

- A. Refer to the Schedule of Submissions for the time period allowed for submission of substitution proposals. The proposal shall state the exact products proposed for substitution and include a cost difference in total savings to the Owner for each proposal.
- B. Include in the proposal complete engineering data, shop drawings, samples and state whether related changes in the project are involved if the proposal is accepted.
- C. No substitutions of products, materials or methods are permitted without written authority by the Architect.
- D. Where no substitution proposal is made within the specified time period, products, materials and equipment shall be submitted and installed as specified.
- E. See Division 01 Specification Sections: Review additional requirements for substitutions.

2.03 SUBMISSIONS:

- A. Refer to the Schedule of Submissions below. Also refer to SUBMITTALS within other Sections of Division 23 in which some of the shop drawings to be submitted are listed. The listing is a minimum listing only. Submit lists of products and subcontractors; detailed drawings, catalog data of all products, equipment and materials required to complete the project and no item shall be ordered, delivered or installed until the reviewed shop drawing submittal is in the possession of the installing contractor.

2.04 SCHEDULE OF SUBMISSIONS:

<u>ITEM</u>	<u>TIME PERIOD</u>	<u>COPIES</u>
LIST OF SUBCONTRACTORS	10 days	7
LIST OF MANUFACTURERS/PRODUCTS	15 days	7
SUBSTITUTION PROPOSALS	20 days	7
SHOP DRAWINGS	25 days	7

Note: The time period above is based on the number of working days after the signing of the contract.

2.05 LIST OF SUBCONTRACTORS:

- A. Submit a complete LIST OF SUBCONTRACTORS proposed for use; including complete firm names, address, and phone numbers.

2.06 LIST OF MANUFACTURERS / PRODUCTS:

- A. Submit a complete LIST OF MANUFACTURERS of materials and equipment specified within this section proposed for use; including materials and equipment proposed by all subcontractors. Partial lists will not be accepted.

2.07 SHOP DRAWINGS:

- A. Provide shop drawings (drawings, catalog cuts, spec sheets) for ALL equipment and products to be installed on the project.
- B. Label all shop drawing submittals as follows:

Project Name
Contractor's Name
Specification paragraph

- C. Mark in ink all catalog cuts, pamphlets to indicate options, accessories and model numbers.
- D. Data submitted which is general and not labeled and marked as required above will not be accepted.

2.08 SHOP DRAWING REVIEW:

- A. Review will be based on manufacturer's published data, and ratings. Any product, material or equipment submitted not in accordance with these specifications will be rejected.
- B. Where substitute products are proposed and no exception is taken, the Mechanical Contractor shall assume the entire responsibility for any changes in the work required or occasioned by the use of the substitute.
- C. Review of shop drawings is not a guarantee of suitable measurements, quantities required, or that other changes in the work are not required to permit proper installation. Review does not mean the submittal has been checked for every detail, or that the Contractor is relieved from responsibility of providing complete systems as required by the Contract Documents.

2.09 RECORD DRAWINGS:

- A. During the period of on site construction, keep at the site, separate from construction documents, accurate construction drawings marked to indicate actual installation of all work of all of the trades specified within Division 23. Drawings shall reflect addenda, change orders, VE items or substitutions accepted for the project. Drawings shall be "red lined" with all modifications on a weekly basis.

- B. All underslab, concealed or underground piping shall be located by dimension sufficient for exact location determination in the future.
- C. All concealed work shall be accurately located and all points of adjustment (dampers etc) shall be shown in actual locations.
- D. Final Record Drawings shall be prepared by the Mechanical Contractor on a set of reproducible drawings which accurately indicate all of the work as installed.

All adjustable setpoints shall be indicated on the drawings at the device sensor or point of adjustment.

- E. Transmit originals and two sets of prints for review at project closeout.
- F. At project closeout transmit final Record Drawings in electronic format indicated below

AutoCad dwg files
PDF files

2.10 OPERATING AND MAINTENANCE MANUALS:

- A. Compile complete manuals including manufacturer's data, bulletins, maintenance instructions, approved shop drawings, parts lists, warranties etc for all equipment and materials provided.

Equipment data shall include:

Manufacturer / Models
Input and output capacities
Service and maintenance recommended actions
Manufacturers published instructions

Operations written narrative:

Include a complete written narrative of how each system and component is intended to operate.

- B. Assemble and index three copies of each manual within suitable binders (8 ½" x 11"). Provide cover clearly indicating project title and "OPERATION AND MAINTENANCE MANUAL".
- C. Transmit manuals to the Architect for review in advance of scheduled instruction periods.

2.11 GUARANTEE:

- A. Transmit to the Architect a written guarantee from each of the Mechanical Contractors stating that the work provided under these specifications is guaranteed against defects in material and workmanship which shall become apparent during the period of one (1) year from acceptance of the systems.

The written guarantee shall list all contractors with contact names and phone numbers, and shall indicate the dates of acceptance of systems and any extended warranties.

The written guarantee shall be posted as directed by the Architect

- B. Extended guarantee or warranty of certain equipment may be required. See specification of individual items.

PART 3 - PRODUCT HANDLING

3.01 PROTECTION AND STORAGE OF MATERIALS:

- A. Equipment and materials furnished shall, at all times, be protected from weather, vandalism, and other construction phase exposures to include paint, plaster and dust.
- B. Outdoor storage of equipment not intended for outdoor use will NOT be permitted.
- C. Properly protect all pipe openings with temporary caps to prevent obstruction and damage. Post notices and prohibit use of fixtures, equipment and apparatus prior to the completion of the project.

3.02 RIGGING, HOISTING, STAGING:

- A. Furnish rigging, hoisting equipment, staging and other services necessary for delivery and installation of any product provided. Remove rigging, staging from the site when no longer required.

PART 4 - PROJECT CONDITIONS

4.01 FIELD MEASUREMENTS AND DISCREPANCIES:

- A. Base all measurements, both horizontal and vertical, from referenced points established by the General Contractor.
- B. Prior to the start of work, check drawings and specifications for discrepancies.
- C. Field verify spaces, dimensions and clearances where materials and equipment will be installed.
- D. Where discrepancies arise which prevent or alter installation, notify the Architect.
- E. Where discrepancies between drawings and specifications; between different drawings; or where the work of others is affecting work under this Division notify the Architect.
- F. Where the work herein required is not clearly understood apply to the Architect for further clarification.
- G. In each instance above, the Architect shall clarify the discrepancy and the Mechanical Contractor(s) shall complete the work at no additional cost to the Owner.

4.02 ACCESSIBILITY:

- A. Install work so that parts requiring access are readily accessible for inspection, operation, maintenance, repair and removal. Minor deviations from the drawings may be made to accomplish this, but changes of magnitude shall not be made without written approval of the Architect.

4.03 TEMPORARY OPENINGS:

- A. Examine contract documents and ascertain whether special, temporary openings will be required for the installation of apparatus and notify the Architect.

4.04 SOLDERING, BRAZING, WELDING:

- A. Soldering, brazing, welding or other open flame operation shall be conducted only when a person, with approved firefighting equipment, trained in its use is on duty at the location of the operation.

4.05 INTERRUPTIONS TO SERVICES:

- A. Where a temporary shutdown of an existing operating system is required, schedule the work at times designated by the Architect. Work requiring an interruption shall be completed by continuous performance, including overtime, to minimize the shutdown interruption.

4.06 USE OF INSTALLATION BY OWNER:

- A. The Owner may use parts of the installation, including mechanical systems when complete, but such use shall not be considered as acceptance of the work in lieu of written certificate from the Architect.
- B. Schedule obnoxious, noisy, or otherwise objectionable portions of the work at times approved by the Architect. Overtime work must be approved in writing.

PART 5 - PRODUCTS AND INSTALLATION

5.01 MATERIALS:

- A. Provide new, first-class quality materials and apparatus, unless specifically directed otherwise by this specification or contract drawings.

5.02 ON-SITE INSPECTIONS

- A. Arrange for and coordinate all on-site inspections with the authorities having jurisdiction.
- B. Review project schedules and insure that such inspections as are necessary are completed in a timely manner.

5.03 MANUFACTURER'S RECOMMENDATIONS, IDENTIFICATION:

- A. Obtain necessary data on equipment and materials to insure proper installation and testing in accordance with manufacturers' recommendations. Install all equipment and material per the recommendations and instructions of the manufacturer; this requirement shall take precedence over other requirements of this specification unless specifically noted.

- B. Equipment and materials furnished for this work shall bear the manufacturers' nameplate, trademark or suitable identification permanently affixed. The nameplate of a contractor or distributor is not acceptable.

5.04 COLOR SELECTION; MATERIALS / EQUIPMENT:

- A. Exterior: Provide metal louvers, grilles, fans, intake units, etc of equal coloration as indicated for exterior metal trim for the project. All exterior metal trim shall match.
- B. Interior: Product color shall be selected by the Architect. Provide complete color selection charts, chips with product submittals. Equipment to be painted shall have prime coat, anti-rust as necessary, factory applied.

5.05 QUIET OPERATION:

- A. Equipment and apparatus provided shall operate under all conditions of load without sound or vibration which are considered objectionable by the Architect. Eliminate same in a manner approved by the Architect.

5.06 ELIMINATION OF TRANSMISSION OF VIBRATION:

- A. Eliminate objectionable transmission of vibration from mechanical systems to building structure. Select and install equipment with proper vibration control equipment and provide isolators on piping, equipment, ductwork and apparatus where necessary to prevent transmission of sound and vibration. Isolate all rotating equipment from the building structure.

5.07 BASES AND SUPPORTS:

- A. Provide all bases and supports for mechanical equipment not part of the building structure of required size, type and strength, as approved by the Architect.
- B. Equipment, bases, and supports shall be anchored to the building structure to prevent shifting of position under all conditions. Attachments shall be strong and of a durable nature and any attachments, anchors, piers, bases, or other supports that are, in the opinion of the Architect, not strong enough or durable shall be replaced as directed.
- C. Equipment bases required for roof mounted equipment shall be as recommended by the roof manufacturer and the Architect.

5.08 SUPPLEMENTARY STEEL, CHANNELS AND SUPPORTS:

- A. Provide steel members, channels as required for the proper installation, mounting and support of equipment provided. Pipe shall not be allowed for use as miscellaneous steel supports. All steel used for support shall be firmly attached to the building construction.
- B. Size and type of supporting steel shall be determined by the installer and shall be of sufficient strength and size to allow only a minimum deflection under all conditions of load.
- C. All steel provided for support shall be free from rust and shall be primed with antirust paint or shall be galvanized. All exterior steel shall be galvanized.

5.09 SLEEVES, PLATES:

- A. Provide and locate sleeves, plates, anchors, and inserts required; mark openings before floors and walls are constructed or core bored.
- B. Provide sleeves for piping passing through floors, walls, roofs, partitions and masonry. Sleeves for concrete or masonry shall be Schedule 40 steel pipe of size to allow for pipe expansion and passage of vapor barrier insulation. Other sleeves shall be 20 gauge galvanized sheet steel with lockseam joint.

Terminate sleeves flush with walls, partitions, and ceiling.
Terminate sleeves 1/2" above finished floor where piping is exposed.

- C. Provide support systems such that access to equipment or appurtenances requiring access are not impeded in any way.

5.10 PIPE ESCUTCHEONS:

- A. Provide escutcheons for pipe penetrations of building construction exposed to view.
- B. Escutcheons shall closely fit bare or insulated pipe and shall conceal pipe sleeves.
- C. Escutcheons in unfinished areas shall be of solid or split pattern steel, cast iron or malleable iron.
- D. Escutcheons in finished areas shall be of chrome plated, solid pattern brass.

5.11 FIRE SAFING: PIPING, DUCTWORK AND EQUIPMENT OPENINGS:

- A. Fire Stop: Pack all piping, ductwork and equipment openings and sleeves full depth with approved fire safing material to fully seal all openings.
- B. Seal all sleeves, core holes, etc. through floors, walls and ceilings with approved fire safing material or fire safing system. Fire safing materials and systems shall be as manufactured by Nelson "Flame-seal", 3-M Systems, Hilti Systems, Metacaulk Firestopping or Dow Corning. Install in accordance with manufacturer's printed instructions.
- C. Firestopping is to meet UL ratings for each penetration type and material for floors, walls and ceilings. Coordinate with Architectural Drawings for exact requirements and ratings at various conditions.
- D. Refer to Section 23 03 00 Mechanical Fire Safing for Specific fire safing requirements.

5.12 MACHINERY DRIVES:

- A. V-belt drives shall be designed to transmit safely equal to or greater than 150% of motor horsepower rating, but not less than manufacturer's recommendation for type of service intended.

5.13 PROTECTIVE GUARDS:

- A. Provide protective guards at all belt drives, rotating shafts and rotating equipment. If not a part of equipment, guards shall be of galvanized angle frame with galvanized wire mesh, readily removable for service.

5.14 PORTABLE OR DETACHABLE PARTS:

- A. Retain and be responsible for all portable or detachable parts provided as a part of the work. Install these parts just prior to project closeout when the site is secure. Replace all lost, stolen or damaged items prior to project acceptance.

5.15 LABELS, VALVE TAGS, PIPE, DUCTWORK, AND EQUIPMENT IDENTIFICATION:

- A. General:

All new systems provided as a part of the contract are to be labeled in a manner that conforms to the following specification. All existing systems, at points of new connection or reconfiguration, shall also be labeled in accordance with the following standards.

All labels, unless otherwise directed, shall be made of hard black plastic. Lettering shall be affected by engraving or incising, and shall be white. All labels shall be securely mechanically attached with screws or equal. Letters and numbers shall be at least 1/4" high, or larger, if required to read clearly from a normal viewing distance. All labels must be made to withstand the temperatures and atmosphere in the area they are to be mounted. Any labels which are to be mounted outdoors must be treated to prevent degradation from sunlight, and must be mounted with stainless steel screws.

Where air or hydronic systems have been balanced, the Contractor shall permanently mark, ON THE DEVICE, the correct balancing setting of each valve, damper, or similar device. This will allow our skilled tradesmen to restore proper operation if the device is tampered with.

All Mechanical Systems to be labeled in accordance with these requirements include, but are not specifically limited to, the following: Additional, specific items may require to be labeled as directed separately in other sections of this specification package.

- B. Pipe Labeling:

Labels for piping shall be Seton Setmark or equal. Labels to identify zone number may be self-stick type, but must wrap completely around pipe, and be adhered to itself. All self-stick labels must be plasticized to withstand washing with commercially available cleaning products.

Piping labels shall be placed over any insulation on the pipe installed. Stenciling on the insulation jacket is not permitted, except as noted above.

For piping outside of Mechanical spaces; labels shall be placed every 40 linear feet of pipe. For piping within Mechanical spaces, labels shall be every 20 feet or as needed to provide clear and concise identification from the floor.

Label must show:

Fluid contained and service
 Flow direction

Pipe Marker Lettering:

<u>Outside Diameter of Pipe Covering</u>	<u>Required Size of Lettering</u>	<u>Tag Length</u>
3/4" to 1-1/4"	1/2"	8"
1-1/2" to 2"	3/4"	8"
2-1/2" to 6"	1-1/4"	12"

Pipe Marker Color Standards:

<u>Pipe Line Type</u>	<u>Description</u>	<u>Background Color</u>	<u>Lettering Color</u>
Gas	Refrigerant	Green	White
	Natural Gas	Yellow	Black
Water	Hot Potable Water	Yellow	Black
	Cold Potable Water	Green	White
	Fire Protection Water	Red	White
Waste	Sanitary Waste	Green	White
	Sanitary Vent	Green	White
	Storm Drain	Green	White
	Condensate Drain	Green	White

C. Valve Tagging:

Labels for valves shall be hard plastic and shall be no smaller than 2" in diameter.

Tags shall have the valve number incised or recessed into the plastic. The tag background and tag lettering shall conform to the color scheme as defined by this standard.

All valve labels shall be permanently attached with steel or brass jack chain, tags shall be color coded to correspond to the following color chart, if product is not listed, consult the Architect/Engineer.

Balancing Valves shall also be provided with tags, permanently marked, with the correct balancing setting. This will allow our skilled tradesmen to restore proper operation if the device is tampered with.

All valve labels must show a number that corresponds to a clearly posted valve legend.

Valve Tag Color Standards:

<u>Pipe Line Type</u>	<u>Description</u>	<u>Background Color</u>	<u>Lettering Color</u>
Gas	Refrigerant	Green	White
	Natural Gas	Yellow	Black
Water	Hot Potable Water	Yellow	Black
	Cold Potable Water	Green	White
	Fire Protection Water	Red	White

D. Equipment:

All pieces of equipment shall be labeled with hard plastic, black plate labels. Lettering shall be white and must be made by engraving or incising the plate.

Any unit which is designed to move volume air shall be appropriately labeled. The hard plastic plate shall show brand; model; system number and function; areas served; design CEM; type of sheave; voltage and phase of service; HP and frame of motor; number and size of belts.

EXAMPLE: UNIT NUMBER: HVAC 1-1
 TRANE BU-15
 ZONE AC-1 / AIR COND / 21,000 CFM
 ADJ Shv - 5 HP - 208/3
 FRM - (3) 4L190 BELTS
 THIRD FLOOR NORTH

Show unit number as stated on the Drawings.
HVAC unit tags shall also state unit service or function.

E. Air Filter Racks and Media:

Filter racks shall be labeled adjacent to the nearest access plate or door, through which the filters may be changed. The hard plastic plate shall show the number of filters required for a complete change-out, and the size of the filters carried on the rack.

EXAMPLE: 24 FILTERS 30x30x4

F. Ductwork: Main Trunks, Main Branches Only:

Labels on ductwork shall be Seton Ventmark or equal. Each label shall show the required information as shown above. Labels shall be mounted over covering on the duct. The label must be mechanically attached. Adhesive backing alone is not acceptable.

Ducts shall be labeled every 30 linear feet of duct. Each duct branch shall be labeled with rooms and areas served.

Show number of system and identify what is carried within. Exhaust Air, Conditioned Air, etc.
Ductwork tags shall also state branch's service or function.

G. Ductwork Accessories:

Show, AT THE DEVICE OR ACCESSORY LOCATION, tags indicating the type of device or accessory located within the ductwork. (i.e. dampers; eliminators; access panels; filter racks; water coils; etc.)

Where systems have been balanced, the Contractor shall permanently mark ON THE DEVICE the correct balancing setting of each damper, or similar device. This will allow our skilled tradesmen to restore proper operation if the device is tampered with.

H. Electric Motor Starters:

Show equipment controlled; Primary and control voltage and phase located within.

I. Automatic Control / Temperature Control Devices:

Show, AT THE LOCATION OF THE DEVICE, tags indicating the type of device or accessory, i.e. temperature, humidity, pressure and current sensors; freezestats; etc. Identify device function.

J. Automatic Control Systems Electrical Conduits:

Labeling for conduit shall be factory-made. Painting or stenciling is not acceptable. Lettering shall include the highest voltage carried within, and shall identify phase. Labeling shall repeat every 30 linear feet. Adhesive backed labels are acceptable here provided the label wraps around the entire circumference of the conduit, and adheres to itself. Otherwise, mechanical fastening with strap is required.

K. Automatic Temperature Control Cabinets:

Each device in each control cabinet shall be affixed with a clear number that shall correspond to a clearly posted control legend. This legend shall identify each device by zone and function. The outer door of the cabinet itself must be labeled with its contents.

In a place within the Mechanical Room selected by the Owner, the Contractor shall mount a clear, reduced set of building prints, showing the systems installed by the Contractor, as-built. These prints shall show zoning by color coding, including all ducts and hydronic piping. Major pieces of equipment shall be highlighted. These prints shall be mounted under a sheet of clear Lexan or Plexiglass.

L. Contractor's Warranty Plate:

Must show the name, address, and telephone number of the contractor who completes the installation, and the date of final acceptance of the installation. THIS DATE WILL BE PROVIDED BY THE OWNER.

M. Access Panels:

On each access panel or door, clearly label the door with a legend description of what is behind the door.

PART 6 - PROJECT CLOSEOUT

6.01 TESTING AND ADJUSTING:

- A. Where testing leaks develop or the installation fails to function properly, make all necessary corrections and repeat tests until all defects have been remedied. Corrections made shall be to the satisfaction of the Architect prior to the acceptance of the work.
- B. Furnish labor, material, and instruments necessary for those tests required. See respective Sections for test requirements.
- C. In addition to required tests specified, provide qualified personnel to adjust all parts of systems such that proper, economical operation is achieved.

- D. Conduct and be responsible for all testing and adjusting of all complete systems to include providing all labor and equipment required and the submission of all reports. Systems shall be operated, tested and adjusted in all modes of operation.
- E. All defects and deficiencies or failing to operate properly shall be corrected by the Contractor and the systems shall be re-tested or readjusted prior to final acceptance.
- F. Any and all damage caused by tests shall be the responsibility of the Contractor.
- G. The balancing of the air conditioning systems shall be performed by an independent balancing contractor.

SEE SECTION 23 95 00 TESTING AND BALANCING.

6.02 SEASONAL SYSTEM TESTS: HVAC

- A. Scope: In addition to other testing and adjusting specified within; and subsequent to the final testing and balancing, all HVAC systems shall be tested to indicate that performance of all units is satisfactory and as intended.
- B. Heating and Ventilating: All systems shall be tested and adjusted for proper operations when the first winter like weather conditions are present.
- C. Air Conditioning System: The entire air conditioning system shall be tested at the first occurrence of summer like weather following project completion; and it shall be established that all controls are performing satisfactorily, and that all units are providing a satisfactory level of cooling. The system shall be checked for vibration and excessive noise, and any such conditions shall be corrected.

6.03 OPERATION, MAINTENANCE INSTRUCTIONS:

- A. Schedule and conduct, after the mechanical -- electrical systems are complete and operational, instruction periods for Owner's personnel. Operation and Maintenance Manuals shall be distributed to the Owner in advance of scheduled instruction periods.
- B. Instruction periods shall include:

- Normal and emergency start up and shut down of all systems
- Normal maintenance requirements for all systems and equipment
- Maintenance tasks and schedules for proper operation.
- Review of Operations and Maintenance Manuals
- Review of AS BUILT drawings

All instruction periods shall be video taped with two copies provided to the Owner.

- C. In addition to instruction periods; a thorough project walk through shall be conducted and the location and access to all points of operation, control and maintenance shall be indicated and noted.
- D. At the completion of instruction periods forward a letter (5 copies) stating the names of those giving and receiving instructions.

6.04 LUBRICATION:

- A. Lubricate, as required, all motors, bearings, fans, etc. before operation of any equipment. Provide a final lubrication when system is accepted by Owner.

6.05 CLEANING:

- A. At completion, thoroughly clean all parts of the installation. Equipment, materials and apparatus shall be free of grease, paint, plaster and debris. Any damage to the building due to leakage or by other means shall be properly and immediately cleaned and repaired to the satisfaction of the Architect.
- B. At completion, replace, clean, such parts of systems as filters, strainers, and traps. This work shall be done after site is substantially free of dust.

6.06 SCRATCHES, SCRAPES, DENTS:

- A. Repair and correct, to the satisfaction of the Architect, all minor equipment deficiencies such as scratches, scrapes, dents; where corrective methods are not satisfactory, replace the item.

6.07 PROJECT CLOSEOUT SUBMITTALS:

- A. Review all project closeout submittal requirements of this specification and transmit in a timely manner.
- B. Provide all required items including (but not limited to):

- Record As Built Drawings
 - Written Guarantee including any extended warranties
 - Operating / Maintenance Instructions Memorandum
 - Testing / Adjusting Logs

6.08 SERVICE:

- A. At completion, provide the Architect with a complete listing of all service contractors including 24-hour phone numbers.
- B. Provide service on equipment furnished for a period of one year from the date of final acceptance. Render service promptly at the request of the Owner. This shall not be construed to include routine maintenance.

END OF SECTION 23 00 00

**SECTION 23 00 50
MECHANICAL: ELECTRICAL COMPONENTS**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 01 and Section 23 00 00 Mechanical General Requirements, and the following listed sections as a minimum, apply fully to work in this section.
- B. Refer to all construction documents including all of the Sections of Division 23 for a complete understanding of the electrical components required. Coordinate with all trades.

Section 23 00 00 MECHANICAL GENERAL REQUIREMENTS

- C. Refer to and coordinate all work with the work of the following listed Sections:

Section 23 01 50 MECHANICAL: VIBRATION ISOLATION
Section 23 03 00 MECHANICAL: FIRE SAFING / FIRESTOPPING

Section 23 10 00 PLUMBING
Section 23 15 00 PLUMBING: FIXTURES

Section 23 30 00 FIRE PROTECTION

Section 23 76 40 HVAC: ELECTRIC HEATING

Section 23 85 00 HVAC: EQUIPMENT

Section 23 90 00 HVAC: CONTROL SYSTEM

Section 23 95 00 HVAC: TESTING ADJUSTING BALANCING

1.02 SCOPE:

- A. Provide labor, equipment and materials to complete the work indicated on drawings and herein specified.

1.03 RELATED WORK:

- A. Work in conjunction with this section shall be as designated below:

General Contractor:

Cutting, Patching, and Painting
Openings in roofs / Flashing
Openings in walls
Equipment foundations and bases
All temporary heating

Electrical Contractor:

Power wiring for electrical equipment provided within this section.

1.04 PROJECT ADMINISTRATION:

- A. Transmit questions, submissions, notices, and correspondence through the general contractor for transmittal to the Architect.
- B. Prepare and transmit to the Architect all submittal requirements within the time period allowed. See Schedule of Submissions.

1.05 SUBMITTALS:

- A. See SUBMITTAL GENERAL REQUIREMENTS within Section 23 00 00.
- B. The following submittals shall be prepared and submitted for approval within the time period stated (see SCHEDULE OF SUBMISSIONS in Section 23 00 00): (The list below is not intended to be all inclusive. Provide submittals for all materials and equipment proposed for use on this project.)

Motor Contactors
Motors
Electrical connection diagrams
Electric Motor Starters

1.06 PROJECT CLOSEOUT:

- A. Review and provide closeout requirements of this section and Section 23 00 00 Mechanical General Requirements, including:
 - Testing and Adjusting
 - Record Drawings
 - Operating, Maintenance Instructions
 - Written Guarantee
 - Lubrication, Filters
 - Operating, Maintenance Manuals
 - Cleaning
 - Test Log
 - Letters of compliance.

PART 2 - ELECTRICAL PRODUCTS / DATA

2.01 GENERAL:

- A. Provide new, standard products, materials and equipment which comply with the specification; are undamaged and unused at the time of installation; are complete with accessories, trim, finish, safety guards and other devices and details needed for a complete installation and for the intended use.

2.02 COMPONENT INSTALLATION:

- A. Provide the electrical components to the electrical equipment installer for mounting and installation.
- B. Combination Electric Motor Starters and Variable Frequency Drives shall not be mounted directly on any mechanical piece of equipment unless specifically indicated on the mechanical drawings.

2.03 EQUIPMENT MINIMUM EFFICIENCIES (SEER)

- A. All equipment proposed for installation shall be in compliance with the current energy code requirements.

2.04 ELECTRICAL CURRENT CHARACTERISTICS:

- A. Refer to the Electrical Drawings and field coordinate the electrical components of the mechanical systems specified in this Division.

Building Electrical Service:	120 / 208V, 3 phase, 4 wire
Motors: 1/2 HP and larger:	208V, 3 phase
Smaller than 1/2 HP:	120V, 1 phase

2.05 ELECTRICAL CONNECTIONS AND WIRING:

- A. The Electrical Contractor shall provide power wiring complete from power source to motor or equipment junction, including power wiring through starters and line voltage control apparatus. The Mechanical Contractor(s) shall furnish and the Electrical Contractor shall install all electric motor starters.
- B. The mechanical/temperature controls contractor(s) shall provide all wiring, relays, transformers, devices, etc. necessary (regardless of voltage) for automatic controls.
- C. Wiring provided by Mechanical Contractor(s) shall be in accordance with the National Electric Code, local and state codes and Division 016. Wiring shall be in conduit, regardless of voltage, unless noted otherwise.

2.06 ELECTRICAL DEVICE COORDINATION:

- A. Coordinate electrical devices, motors with the Electrical Contractor and electrical drawings as to voltage, starter location and control required. Provide electrical data and wiring diagrams to the Electrical Contractor.
- B. Power and / or signaling requirements for each mechanical device shall be coordinated with the Electrical Contractor prior to the start of the electrical systems installation
- C. Do NOT allow installation of starters and drives mounted directly to mechanical equipment without prior approval. All devices are to be mounted with separate supports as required.

D. Do NOT operate electrical devices until:

- Voltage available on all phases is in accordance with nameplate.
- Direction of rotation is checked.
- Full load voltage reading is not less than nameplate.
- Full load amperage reading is not greater than nameplate.

E. The Mechanical Contractor(s) shall furnish the Electrical Contractor with copies of the Mechanical System floor Plans, (Plumbing, Fire Protection and HVAC). These drawings shall have all equipment and systems requiring electrical connection clearly marked in red. Copies of these "Electrical Coordination Drawings" shall also be submitted for record.

F. Power and / or signaling requirements for each mechanical device shall be coordinated with the Electrical Contractor prior to the start of the electrical systems installation.

2.07 COORDINATION WITH NSTAR STANDARDS FOR SYSTEM EFFICIENCY:

A. The components of the Mechanical Systems as herein specified and as provided by the Contractors shall conform to the parameters as defined by NSTAR. Equipment to be provided shall be selected for Maximum Energy Efficiency as required to allow the Owner to receive the maximum possible energy incentive rebate for the use of energy efficient mechanical systems.

B. Equipment to be selected and provided to allow the maximum possible energy incentive rebates shall include, but are not limited to the following:

- Electric Motors
- Air- to- Air Heat Pump Systems
- Energy Recovery Ventilators

C. As a part of the required submittal data, the Contractors shall furnish invoices and material delivery slips clearly identifying the mechanical system components provided. Manufacturer's submittal data shall be clearly marked to indicate the product's efficiency and compliance with the National Grid minimum efficiency requirements.

2.08 MOTORS:

<u>HP</u>	Minimum Nominal Efficiency <u>ODP</u>	Minimal Nominal Efficiency <u>TEFC</u>
1.0	85.5	85.5
1.5	86.5	86.5
2.0	86.5	86.5
3.0	89.5	89.5
5.0	89.5	89.5
75.0	95.0	95.4
100.0	95.4	95.4

2.09 ELECTRIC MOTOR STARTERS:

- A. Manufacturer: Cutler-Hammer
 Square D
 Allen Bradley
 General Electric

- B. Types Required:

 Start/Stop Automatic control at Equipment:

 Start/Stop Automatic control at Remote Location:

- C. Provide proper heater in all motor starters furnished.

- D. Check proper rating of thermal overloads. Replace any overloads found to be of an incorrect rating. Provide a spare set of thermal overloads for each starter and leave inside starter enclosure.

- E. Provide a minimum of two (2) sets of auxiliary contacts of convertible type N.O. to N.C. for each starter. Motor starters shall have NEMA I enclosures. Those in wet locations shall be NEMA 3R.

END OF SECTION 23 00 50

SECTION 23 01 50
MECHANICAL: VIBRATION ISOLATION

PART 1 GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 01 and the following listed sections as a minimum, apply fully to work in this section.

Section 23 00 00 MECHANICAL GENERAL REQUIREMENTS

- B. Refer to and coordinate all work with the work of the following listed sections:

Section 23 00 50 MECHANICAL: ELECTRICAL COMPONENTS

Section 23 02 50 MECHANICAL: PIPE HANGERS AND SUPPORTS

Section 23 10 00 PLUMBING
Section 23 15 00 PLUMBING: FIXTURES
Section 23 17 00 PLUMBING: NATURAL GAS PIPING

Section 23 30 00 FIRE PROTECTION

Section 23 55 00 HVAC: HYDRONIC SYSTEMS

Section 23 56 50 HVAC: REFRIGERANT SYSTEMS

Section 23 57 00 HVAC: NATURAL GAS PIPING

Section 23 76 40 HVAC: ELECTRIC HEATING

Section 23 80 00 HVAC: AIR HANDLING SYSTEMS
Section 23 85 00 HVAC: EQUIPMENT

Section 23 95 00 HVAC: TESTING ADJUSTING BALANCING

1.02 GENERAL REQUIREMENTS:

- A. Provide vibration isolation supports for all air systems, equipment and piping as outlined below.
- B. Devices shall be selected, installed, and adjusted in a manner to prevent objectionable vibration transmission to the structure.
- C. Seismic restraints are not included in this section of the specification. See Division 23, Section 23 02 00 MECHANICAL SEISMIC RESTRAINT for seismic restraint requirements. All restraints to be separate and not interfere with vibration isolation devices or must be fully consolidated to perform both tasks.

1.03 APPROVED MANUFACTURERS:

- A. Provide all vibration isolation devices, including auxiliary steel bases and pouring forms, as designed by a single manufacturer.
- B. Approved manufacturers: Mason Industries
Kenetics
Amber-Booth
Vibration Mountings and Controls
- C. Engage manufacturer to provide technical supervision of installation of vibration control products.

1.04 SUBMITTALS:

- A. The following submittals shall be prepared and submitted for approval within the time period stated (see SCHEDULE OF SUBMISSIONS in Section 23 00 00): (The list below is not intended to be all inclusive. Provide submittals for all materials and equipment proposed for use on this project.)
- B. Vibration Isolators: Provide catalog cuts, show drawings and other documents as necessary to indicate equipment unit number, isolator type, scheduled deflection, proposed deflection under operating load, spring free height, spring operating height, spring solid height (at coil bind), and spring coil diameter for each isolator. Indicate the weight and lowest rotational speed of equipment supported by each isolator.

Submittal Format:	Example:
Supported Equipment	AHU-1
Isolator Type	Mason SLF
Equipment Weight	4900 lbs
Lowest Speed	800 RPM
Schedule Deflection	2.5 inches
Operating Deflection	2.6 inches
Spring Free height	9.6 inches
Operating Height	7.0 inches
Solid Height	5.6 inches
Spring Height	6.2 inches
Remarks:	

- C. Equipment Bases: Provide detailed drawings for steel bases and fan sub-bases showing all steel work, reinforcing, method of isolator attachment, and location of equipment attachment bolts.
- D. Reports: Provide inspection reports from the isolator manufacturer or representative indicating that the installations are complete and correct in every respect.
- E. Shop Drawings: submit shop drawings and manufacturer's installation instructions for thrust restraints wherever they are required.
- F. Submission of samples may be requested for each type of vibration isolator device. After approval, samples will be returned for installation at the job. All costs associated with submission of samples shall be borne by the Contractor.

1.05 DRAWINGS:

- A. Detailed drawings are schematic only. The size and number of mounts and hangers shall be chosen to meet these specifications.

PART 2 – PRODUCTS

2.01 GENERAL REQUIREMENTS:

- A. Steel springs and neoprene elements shall have static deflections under operating load equal or greater than deflections shown on the schedules. Isolators submitted on the basis of rated loads will be disapproved.
- B. All steel springs as installed shall have minimum additional travel to solid (coil bind) equal to 50% of the deflection under operating load.
- C. Spring diameter shall be no less than 0.8 of the compressed height of the spring at operating load.
- D. All neoprene components shall be selected for maximum hardness of 40 durometer, show A rating where possible. In no case shall hardness exceed 50 durometer. Bridge bearing quality neoprene meeting AASHTO Highway Bridge Specifications shall be used in all elastomeric components where installed in irretrievable locations and as noted elsewhere in the documents.
- E. All isolators supporting a given piece of equipment shall be selected for approximately equal spring deflection.
- F. Steel springs shall not take a permanent set when compressed to coil bind.
- G. Steel springs shall be color-coded to allow positive identification after installation.

2.02 CORROSION PROTECTION:

- A. All vibration isolators and associated hardware shall be designed or treated for resistance to corrosion.

2.03 VIBRATION ISOLATOR TYPES:

- A. Type A: Elastomeric pads shall be waffled or ribbed neoprene pads Mason model Super W., Amber-Booth model NR, Kinetics model NP or approved equal; or ribbed or waffled neoprene pads with steel shim plate Mason model WSW, Amber-Booth model SP-NR style E. or approved equal. Size pads for deflection equal to 10-20% of unloaded height; bridge bearing quality pads shall be loaded 10-15%.
- B. Type B: Neoprene-In-Shear floor mount isolators shall have steel bottom plates with bolt holes for bolting to foundations, a threaded steel insert at top of the mounting for attaching equipment, and friction surfaces both top and bottom. All metal surfaces shall be neoprene covered to resist corrosion. Mounts shall be double deflection and designed for 0.25 – 0.35 inches deflection at rated load. Isolators shall be Mason model ND, Amber-Booth model RVD, Kinetics model RD or approved equal.

- C. Type D: Open spring floor mount isolators shall be free standing and laterally-stable with no housing, and shall have leveling adjustment bolts which shall be rigidly bolted to the equipment. Provide with ¼ inch minimum elastomeric friction pad Type A between the baseplate and the support. Vibration isolator vendor shall size elastomeric pads and associated load distributing shim plates to achieve deflection equal to 10-20% of the vertical thickness of the pads. If the mounting base plate is to be bolted to the structure, elastomeric grommets shall be used between the bolts and the isolators to prevent mechanical short-circuit. Bolt holes shall be properly sized to allow for bushings. The hold-down bolt shall use steel washers to distribute load evenly over neoprene washers. Isolators shall be Mason model SLF, Amber-Booth model SW, Kinetics model FDS or approved equal.
- D. Type E. Restrained open spring floor mount isolators for windy rooftop locations and/or for equipment with operating weight greater than installed weight shall have built-in adjustable limit stops to prevent equipment from rising when weight is removed. Isolators shall be as Type D above plus height-limiting studs and adjustable nuts, with ½ inch minimum clearance around the studs. Isolators shall be Mason model SLR, Amber-Booth model CT, Kinetics model FLS or approved equal.
- E. Type F. Elastomeric hanger shall be a neoprene-in-shear element mounted in a hanger box. The neoprene element shall be molded with a rod isolation bushing that prevents the rod from contacting the hanger box. Design for 0.25 – 0.35 inch minimum static deflection at rated load. Isolators shall be Mason model HD, WHD, Amber-Booth model BRD, Kinetics model RH or approved equal.
- F. Type G: Spring-and-neoprene-in-series hangers shall contain a steel spring and 0.3 inch deflection elastomeric element in series. Neoprene elements shall be molded with a rod isolation bushing that passes through the hanger box. The diameters of the spring and the hole in the mounting box shall allow for 15 degree misalignment from vertical before mechanical short circuit occurs. Isolators shall be Mason model 30N, Amber-Booth model BSRA, Kinetics model SRH or approved equal.
- G. Type H: Precompressed spring-and-neoprene-in-series hangers shall be equal to Type G including 15 degrees misalignment capability. Isolator shall be precompressed to the rated deflection to allow installation at a fixed elevation. Hangers shall have a release mechanism to free the spring after installation and the hanger is subject to its full load. Deflection shall be indicated by means of a scale. Isolators shall be Mason model PC30N, Amber-Booth model PBSRA or approved equal.
- H. Type J: If thrust restraints are used, they shall be in sets of two or more, and shall be the spring-in-series-neoprene type. Deflection shall be equal to deflection of isolators supporting the unit being restrained. Provide thrust restraints complete with rods and adjustment nuts, plug angle brackets and backing plates for attachment to the unit being restrained and anchor supports. Thrust restraints shall be Mason model WB or approved equal.
- I. Flexible neoprene piping connectors shall be straight-through twin spherical type, or single sphere elbow type, manufactured of nylon cord and neoprene with no steel wire or rings used as pressure reinforcements. Connectors shall be able to accept elongation, compression, axial and transverse movement. Connectors shall be selected to suit the system temperature, pressure and fluid type. Connectors shall be Mason “Safeflex” model SFDE, SFDCR, or approved equal. Straight wall connectors are not acceptable, except for sump pumps.
- J. Elastomeric grommets may be a combination of neoprene washer and busing, Mason models HLIW and HLIB or approved equal. Elastomeric grommets shall be 60 durometer maximum and shall be formed to prevent bolts from directly contacting the secured item.

- K. Captive neoprene wall-mount isolators shall be Mason model RBA, RCA, or approved equal.
- L. Reference electrical specification for flexible conduit specification.

PART 3 – EXECUTION

3.01 MANUFACTURER'S RESPONSIBILITY:

- A. The vibration isolation manufacturer or his authorized representative shall alert the Engineer to any isolator selections which may experience resonance with the approved equipment and upgrade any isolators that are found to resonate with the supported equipment. He shall provide supervision as may be necessary to assure correct installation and adjustment. He shall submit a written report to the Architect at completion of the Work, certifying correctness of the installation and compliance with Contract Documents.

3.02 GENERAL:

- A. All equipment and piping shall be resiliently mounted on or suspended from approved foundations and supports, with isolation pads, mounts and hangers as specified herein and as shown on drawings. Contractor shall cooperate with the Architect to replace any isolators that need to be upgraded from what is shown on the drawings if equipment operating results in resonance with building natural frequencies.

3.03 MOUNTS AND HANGERS:

- A. Location of all vibration isolation equipment shall be selected for ease of inspection and adjustment as well as proper operation.
- B. Installation of vibration isolation equipment shall be in accordance with the manufacturer's instruction.
- C. All vibration isolators shall be aligned squarely above or below mounting points of the supported equipment.
- D. Isolators for equipment with bases shall be located on the sides of the bases that are parallel to the equipment shaft unless this is not possible because of physical constraints.
- E. If a housekeeping pad is provided, the isolator base plate shall rest entirely on the pad.
- F. Hanger rods for vibration isolated support shall be connected to structural beams or joists, not from the floor slab between beams and joists. Provide intermediate support members as necessary.
- G. Vibration isolation hanger elements shall be positioned as high as possible in the hanger rod assembly, but not in contact with the building structure so that the hanger housing may rotate a full 360 degrees about the rod axis without contacting object.
- H. Adjust all leveling bolts and hanger rod so that the isolated equipment is level and in proper alignment with connecting ducts or pipes.
- I. Limit stops shall be out of contact during normal operation.

3.04 FLOOR CLEARANCES:

- A. All floor-mounted equipment shall have a minimum operating clearance of 1/2" between the bottom of the equipment or inertia base and the floor or housekeeping pad. The general contractor shall check to ensure that this space is completely clear after installation is complete. Provide height-saving brackets as shown or as needed. Where housekeeping pads are provided, these shall be greater in area than the footprint of the support equipment, in order to accommodate bases of vibration isolators, especially where outboard mounts are used with height-saving brackets.

3.05 DEFLECTIONS:

- A. Vibration isolation systems shall be designed to have deflections equal to or greater than indicated on the schedule and drawings. Where multiple deflection requirements apply to a single isolator, the greater deflection shall prevail. Isolators supporting asymmetrical loads shall be selected for equal deflection under actual load. The number of mountings and sizes shall be determined by the vibration isolation manufacturer, and shall be installed in accordance with manufacturer's instructions.

3.06 THRUST RESTRAINTS:

- A. Maximum motion shall be 1/4" under start-up and shut-down conditions for each floor or ceiling supported piece of equipment. Motions in excess shall be restrained by approved thrust restraints Type J attached at the centerline of the thrust, and arranged symmetrically on the unit. The restraints shall be anchored to fixed supports of stiffness greater than the thrust to be countered, and not to associated ductwork. Adjust according to manufacturer's instruction. Shop drawings and manufacturer's instructions for thrust restraints shall be submitted for approval prior to installation.

3.07 CORROSION RESISTANCE:

- A. Treat isolation systems for corrosion resistance. Coatings damaged during installation shall be repaired.

3.08 INDEPENDENT SUPPORTS:

- A. Isolated systems shall be independent. Piping, ductwork, conduit or mechanical equipment shall not be hung from or supported on other equipment, pipes or ductwork installed on vibration isolators. Maintain 2" clearance between isolated equipment and walls, ceilings and other equipment. Drain piping connected to vibration isolated equipment shall not contact the building structure or other non-isolated systems.

3.09 PACKAGED HEAT PUMP UNITS:

- A. Packaged type heat pump units shall be mounted on steel spring vibration isolators providing a minimum static deflection of 1-1/2". Isolators shall incorporate a built-in leveling device, acoustical pad 1/2" thick cemented to the underside of the mounting and system for lateral restraint. Non-friction type resilient checks shall also be provided. The mounting shall be Mason Industries, Inc., Type SLR, or approved equal, suitable for outdoor use.
- B. Isolators shall be secured to supporting structure.

3.10 MOUNT SUSPENDED HORIZONTAL FANS, ENERGY RECOVERY UNITS AND HVAC UNITS AS FOLLOWS:

- A. Units shall be hung by spring and neoprene in Type G series hangers.
- B. If equipment to be mounted is not furnished with integral structural frames and external mounting lugs of suitable strength and rigidity, approved structural sub-base shall be installed in the field which shall support equipment and to which hangers shall be attached.
- C. Thrust restraints Type J shall be provided as required to limit motion to ¼” maximum under fan operating, start-up and shut-down conditions.

3.11 MOUNT IN-LINE PUMPS AS FOLLOWS:

- A. Vibration-isolating pipe hangers sized to carry both the pipe and pump loads shall be installed near the suction and discharge ends of each in-line pump.

3.12 SUPPORT DUCTWORK AS FOLLOWS:

- A. Flexible duct connections as described elsewhere in this specification shall be provided at all fan inlets and outlets between the fan and the first duct hanger or support.
- B. In slabs and walls, provide a ½” to 1” clearance for all penetrating ducts when not precluded by fire dampers. Pack the clear space full-depth with fiberglass insulation, and caulk penetration airtight on both sides of wall or slab.

3.13 SUPPORT PIPES AS FOLLOWS:

- A. For all pipes over 1” in diameter, provide metal sleeves sized for ¼” to ½” clearances at wall and slab penetrations, and seal tightly in place. Pack with fiberglass insulation, and caulk airtight at each end of the sleeve.

3.14 CURB-MOUNTED ROOFTOP FANS:

- A. Fans shall be supplied with factory installed neoprene vibration isolators separating the motor, drive assembly and impellor from the base. There shall be no rigid short circuit of these isolators through bolting, rigid conduit or other components of the curb-mounting assembly. Type A elastomeric pads, correctly sized, shall be installed to entirely separate the fan base from the curb.

3.15 CURB-MOUNTED ROOFTOP ENERGY RECOVERY UNITS:

- A. Units shall be mounted on vibration isolating type roof curbs as manufactured by Thy-curb or Novia. Roof curbs shall be specifically engineered and manufactured for the units they support. Curb shall be thermally broken insulated type with minimum R-10 where curbs penetrate any roof insulation layers as required by passive house.

END OF SECTION 23 01 50

SECTION 23 02 50
MECHANICAL: PIPE HANGERS AND SUPPORTS

PART I GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 01 and the following listed sections as a minimum, apply fully to work in this section.

Section 23 00 00 MECHANICAL GENERAL REQUIREMENTS

- B. Refer to and coordinate all work with the work of the following listed sections:

Section 23 01 50 MECHANICAL: VIBRATION ISOLATION

Section 23 04 00 MECHANICAL: INSULATION

Section 23 10 00 PLUMBING
Section 23 17 00 PLUMBING: NATURAL GAS PIPING

Section 23 30 00 FIRE PROTECTION

Section 23 55 00 HVAC: HYDRONIC SYSTEMS

Section 23 56 50 HVAC: REFRIGERANT SYSTEMS

1.02 SCOPE:

- A. Section Includes: Pipe hangers and supports, pipe saddles and shields, and pipe guides and anchors for piping systems except for fire protection piping systems.

1.03 PROJECT ADMINISTRATION:

- A. Transmit questions, submissions, notices, and correspondence through the general contractor for transmittal to the Architect.
- B. Prepare and transmit to the Architect all submittal requirements within the time period allowed. See Schedule of Submissions.

1.04 SUBMITTALS:

- A. See SUBMITTAL GENERAL REQUIREMENTS within Section 23 00 00.
- B. The following shop drawings shall be prepared and submitted for approval within the time period stated (see SCHEDULE OF SUBMISSIONS in Section 23 00 00): (The listing below is not intended to be all-inclusive. Provide submittals for all materials and equipment proposed for use on this project.)

Product data sheets: Provide product data sheets for all hangers and supports intended for use on the project.

Pipe Hangers
Hanger Rod
Structural Attachments
Insulation Shields
Sleepers

1.05 QUALITY ASSURANCE:

- A. Pipe hangers, pipe supports, hanger and support accessories, pipe saddles and pipe shields, where applicable, shall comply with provisions of latest edition of ASME Code for Pressure Piping ANSI/ASME B31.1 - Power Piping, Fed. Spec. No. WW-H171, Manufacturers' Standardization Society Standard Practice SP-58 and SP-69, and these Specifications. Where there is conflict, these Specifications shall govern.
- B. Hangers, supports, accessories, saddles and shields shall be load-rated. Load ratings shall be established by manufacturers based upon testing and analysis in conformance with above referenced codes. Manufacturers load tests shall be made on both supporting materials and configurations. Tests shall be performed by independent testing laboratory. Results of these tests shall be made available to the Owner upon request.
- C. Manufacturers shall select hangers, supports, accessories, saddles and shields based on load ratings for applications involved.

PART 2 PRODUCTS

2.01 PIPE HANGERS AND SUPPORTS:

- A. Manufacturer(s) Specified:

Grinnell Corp.
Carpenter & Paterson, Inc.
Michigan Hanger Co., Inc.
Penn Pipe Hangers Div. of Penn Construction Industries
Power Piping Co.
Basic Engineers, Inc.
National Pipe Hanger Corp.
B-Line Systems, Inc.

- B. General Requirements:

Pipe hangers, supports and accessories specified herein are from master specifications and include hangers, supports and accessories for various piping materials and applications. Refer to related Sections for actual piping materials required for the Project and select hangers, supports and accessories for applications involved.

Auxiliary structural steel, not part of building structure, required for support of piping shall be as required and necessary. Provide unistrut of strength required. Pipe used as supports is not acceptable. All metal surfaces shall be painted. Metal exposed to weather shall be galvanized.

Unless otherwise shown or specified, hangers, supports and accessories for insulated piping systems shall be sized to accommodate pipe insulation system, and shall fit around outside of pipe insulation without crushing and penetrating pipe insulation. Refer to specifications for piping insulation for detailed specifications of insulation and inserts at hangers and supports.

Hangers, supports and accessories exposed to weather or corrosive environments shall be protected with factory-applied corrosion-resistant finish. Provide galvanized or cadmium-plated finish except when it is specified that components and assemblies are to be constructed of stainless steel, or copper-plated steel.

Certain piping shall be resiliently supported. Refer to requirements for vibration isolation.

C. Upper Attachments:

Hanger rod shall be threaded steel, Grinnell Fig. 146 or 140.

Rod couplings shall be steel, Grinnell Fig. 135.

Extension pieces shall be malleable iron, Grinnell Fig. 157

Eye rods shall be threaded steel, Grinnell Fig. 248.

U-bolts shall be steel, Grinnell Fig. 137 with nuts.

D. Pipe Attachments:

Hangers for bare steel pipe 2" and smaller shall be Grinnell Fig. 65 light-duty steel clevis hangers. For 2-1/2" and larger use Grinnell Fig. 260 standard-duty steel clevis hangers.

Hangers for bare copper tubing 4" and smaller shall be Grinnell Fig. CT-69 adjustable, copper-plated steel, swivel ring hangers or Grinnell Fig. CT-65 lightweight, copper-plated steel, adjustable clevis hangers. For 5" and larger use Carpenter & Paterson Fig. 800 CT adjustable, swivel type, copper-plated steel ring hangers.

Hangers for bare cast iron soil pipe shall be Grinnell Fig. 260 standard-duty steel clevis hangers.

Hangers for insulated pipe and tubing of 4.1/2" OD combined and smaller shall be Grinnell Fig. 65 light-duty steel clevis hangers. Above 4-1/2" OD combined, use Grinnell Fig. 260 standard-duty steel clevis hangers.

E. Risers:

Riser clamps for bare steel pipe 20" and smaller shall be Grinnell Fig. 261 steel riser clamps. Weld support lugs on pipe 4" and larger.

Riser clamps for bare copper tubing 4" and smaller shall be Grinnell Fig. CT-121 copper-plated steel riser clamps. For 5" and larger use Grinnell Fig. 261 steel riser clamps with 4 psf lead sheet between pipe and clamp. Braze bronze support lugs on tubing 4" and larger.

Riser clamps for Schedule 40 PVC pipe shall be Grinnell Fig. 261 steel riser clamps. Locate under coupling or bell of pipe.

Riser clamps for cold (70 degrees F and below) insulated black steel pipe shall be Series E insulated pipe riser clamps as manufactured by Pipe Shields, Inc. or insulated pipe riser clamps as manufactured by Basic Engineers, Inc., Power Piping Co. and no others. Insulation shall prevent condensation in ambient conditions. Riser clamps shall include: Galvanized steel-jacketed

structural inserts of high density calcium silicate, 600 psi minimum compressive strength, water-repellent treated; primed steel thrust plates for field welding to pipe; and primed steel straps with cadmium-plated fasteners.

Riser clamps for cold (70 degrees F and below) insulated copper tubing shall be Series E insulated pipe riser clamps as manufactured by Pipe Shields, Inc. or insulated pipe riser clamps as manufactured by Basic Engineers, Inc., Power Piping Co. and no others. Insulation shall prevent condensation in ambient conditions. Riser clamps shall include: Galvanized steel-jacketed structural inserts of high density calcium silicate, 600 psi minimum compressive strength, water-repellent treated; copper thrust plates for field brazing to tubing; and copper straps with bronze or cadmium-plated fasteners.

2.02 PIPE SHIELDS:

- A. Provide the following at pipe hangers and supports:

Insulation Shields:

Provide galvanized steel insulation shields at locations of pipe hangers for piping systems with ID less than 2". Insulation shields shall extend 6" on either side of hanger and shall be with rounded edges.

PART 3 EXECUTION

3.01 PIPE HANGERS AND SUPPORTS:

- A. General:

Supports shall secure pipes in place, prevent swaying and vibration, maintain required grading by proper adjustments and provide for expansion, contraction, anchorage and piping insulation protection. Design supports of strength and rigidity to suit loading and service. Include weight of water and fluids wed for cleaning and testing. Supports shall not unduly stress building construction.

Installation of pipe hangers and supports shall conform to:

Manufacturers Standardization Society (MSS) Standard Practice:

SP-69 Pipe Hangers and Supports - Selection and Application

In case of conflict, more stringent requirements shall apply.

- B. Hanger and Support Spacing:

Pipe hangers and supports shall be selected and spaced on basis of building structure, loading limitations, imposed loads, and pipe stress. Tables below are based on pipe stress only.

Maximum pipe hanger and support spacing dimensions specified or listed herein are for bare pipe without additional loads such as flanges, valves, piping specialties, accessories, insulation or other forces. Certain spacing dimensions are recommended by piping manufacturers or are accepted good practice. Reduce spacing from maximums shown or specified as required to accommodate actual imposed loads of piping systems in conjunction with load limitations of

building structure and elements of pipe hanger and support systems including pipe saddles, pipe shields and inserts.

Maximum spacing of hangers and supports for standard weight steel pipe shall conform to requirements of ANSI/ASME B31.1 - Power Piping and Manufacturer's Standardization Society Standard Practice (MSS) SP-69. Pipe Hangers and Supports for reference as follows:

Pipe Size Inches	Maximum Spacing	Maximum Spacing
	Feet Water Service	Feet Vapor Service
½ and smaller	7	8
¾, 1, 1-1/4	7	9
1-1/2	9	12
2	10	13
2-1/2	11	14
3	12	15
4	14	17
5	16	19
6	17	21

Maximum horizontal spacing of hangers and supports for copper tubing shall conform to requirements of manufacturers Standardization Society (MSS) Stand Practice SP-69 listed for reference as follows:

Nominal Tube Size Inches	Maximum Spacing	Maximum Spacing
	Feet Water Service	Feet Vapor Service
½ & 3/8	5	6
¾	5	7
1	6	8
1-1/4	7	9
1-1/2	8	10
2	8	11
2-1/2	9	13

For Schedule 40 PVC piping, provide minimum of one (1) hanger per pipe section and locate close to joint on pipe bar Provide hangers at changes in direction and at branch connections. Maximum hanger spacing shall not exceed 10 feet.

Provide supports for riser (vertical) piping at each floor except where shown or specified otherwise.

C. Intermediate Attachments:

Attachments shall be selected on basis of building structure and loads to be supported. Maximum applied loads shall not exceed manufacturer's published load data. Install per manufacturer's instructions.

D. Pipe Attachments:

Do not hang one pipe from another or from ductwork and conduits. Do not use perforated band iron, wire or chain as hangers.

Unless otherwise specified or shown on the Drawings, piping shall be suspended by individual hangers.

Drainage piping shall be suspended by individual hangers only.

Where piping must be suspended closer to overhead than is possible with single rod clevis hangers, trapeze supports shall be used as specified further herein.

At pipe bends, place hanger no more than ½" from bend.

Apply double wraps of 3M Co. No. 51 Scotchwrap PVC tape with pressure-sensitive adhesive around bare piping where piping materials are dissimilar from pipe attachments. Scotchwrap is not required where pipe attachments are specified to have protective coating or match piping material being supported.

Select and install pipe attachments to permit expansion and contraction.

3.02 PIPE SHIELDS:

- A. Install pipe shields on flexible foamed insulation such that shield is centered under insulation inserts. Coat inserts with compatible wet adhesive and insert into snugly cut undersized holes in pipe insulation. Stabilize large and heavy pipes with additional inserts (hardwood dowels) at 4 and 8 o'clock positions. After installation, coat outer surface and vapor-seal with adhesive, then apply layer of pressure-sensitive adhesive vapor barrier tape.
- B. Coordinate the Work with insulation subcontractor.

END OF SECTION 23 02 50

SECTION 23 03 00
MECHANICAL: FIRE SAFING / FIRESTOPPING

PART 1 GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 01 and the following listed sections as a minimum, apply fully to work in this section.

Section 23 00 00 MECHANICAL GENERAL REQUIREMENTS

- B. Refer to and coordinate all work with the work of the following listed sections:

Section 23 00 50 MECHANICAL: ELECTRICAL COMPONENTS

Section 23 04 00 MECHANICAL: INSULATION

Section 23 10 00 PLUMBING

Section 23 17 00 PLUMBING: NATURAL GAS PIPING

Section 23 30 00 FIRE PROTECTION

Section 23 55 00 HVAC: HYDRONIC SYSTEMS

Section 23 56 50 HVAC: REFRIGERANT SYSTEMS

Section 23 80 00 HVAC: AIR HANDLING SYSTEMS

Section 23 90 00 HVAC: CONTROL SYSTEM

1.02 SCOPE:

- A. Provide labor, equipment and materials to complete the Firesafing / Firestopping work as herein specified.

1.03 RELATED WORK:

- A. Work in conjunction with this section shall be as designated below:

General Contractor: Cutting, Patching, and Painting
Flashing
Openings in walls

1.04 PROJECT ADMINISTRATION:

- A. Transmit questions, submissions, notices, and correspondence through the general contractor for transmittal to the Architect.
- B. Prepare and transmit to the Architect all submittal requirements within the time period allowed. See Schedule of Submissions.

1.05 SUBMITTALS:

- A. See SUBMITTAL GENERAL REQUIREMENTS within Section 23 00 00.
- B. The following shop drawings shall be prepared and submitted for approval within the time period stated (see SCHEDULE OF SUBMISSIONS in Section 23 00 00): (The list below is not intended to be all-inclusive. Provide submittals for all materials and equipment proposed for use on this project.)
- C. Shop Drawings: For each different firestopping configuration, provide the following:

Listing agency's detailed drawing showing opening, penetrating items, and firestopping materials, all of which are identified with listing agency's name and number or designation, fire rating achieved, and date of listing.

Identify which rated assembly each system is to be used in.

Any installation instructions that are not included on the detailed drawing.

For proposed systems that do not conform strictly to the listing, submit listing agency's drawing marked to show modifications and stamped approved by firestop system manufacturer's fire protection engineer.

- D. Submit listing agency's test report showing compliance with requirements, based on testing of current products.
- E. Product Certificates: Submit certificates signed by firestop system manufacturer certifying that materials furnished comply with requirements.
- F. Product Data: Manufacturer's data sheets on each material to be used in firestop system systems, including:

Product characteristics and Material Safety Data Sheets.
Listing numbers of systems in which each product is to be used.
Preparation instructions and recommendations.
Storage and handling requirements and recommendations.
Installation methods.

Installer's Qualification Documentation.

1.06 REFERENCES:

ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2000a.

ASTM E 119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2000a.

ASTM E 814 - Standard Test Method for Fire Tests of Through-Penetration Fire Stops; 2000.

ASTM E 1399 - Standard Test Method for Cyclic Movement and Measuring the Minimum and Maximum Joint Widths of Architectural Joint Systems; 1997 (Reapproved 2000).

ASTM E 1529 - Standard Test Methods for Determining Effects of Large Hydrocarbon Pool Fires on Structural Members and Assemblies; 2000.

ASTM E 1725 - Standard Test Methods for Fire Tests of Fire-Resistive Barrier Systems for Electrical System Components; 1995 (Reapproved 2001).

UL 1479 - Standard for Fire Tests of Through-Penetration Firestops; 1994.

UL 1709 - Rapid Rise Fire Tests of Protection Materials for Structural Steel; 1994.

ANSI/UL 2079 - Tests for Fire Resistance of Building Joint Systems; 1998.

1.07 DEFINITIONS:

- A. Construction Gap: An open joint between adjacent rated assemblies; may be a moving joint or static opening, without penetrating items.
- B. Firestop System: Specific firestop material or materials, which when installed in openings in a specific rated assembly, achieve the performance required.
- C. Firestopping: Result of installation of firestop system.
- D. Listing: The current, published listing of a system in a qualified listing agency's directory.
- E. Listing Agency: Independent testing agency that has conducted tests and classified firestop systems for particular applications, which conducts routine in-plant follow-up inspections, and which lists tested systems in a published directory.
- F. Penetrating Item: Any item (pipe, duct, conduit, cable, etc.) that passes completely through a rated assembly through an opening of any size.
- G. Rated Assembly: A wall, floor, roof/ceiling, or other construction that is required to have an hourly fire rating or a smoke resistance rating.
- H. Through Penetration: A hole through a rated assembly made to accommodate the passage of a penetrating item or an empty hole made for another purpose and not repairable using the original materials of construction.

1.08 QUALITY ASSURANCE:

- A. Installer Qualifications: Firm who is qualified by having experience, staff, and training to install the specified products, and who:
 - Is a Certified and Trained contractor in the field of fire stopping and fire safing.
 - Is acceptable to or licensed by manufacturer.
 - Is acceptable to or licensed by authority having jurisdiction.
 - Has completed the manufacturer's certified product installation training.
 - Can provide a list of completed projects as evidence of experience; include project name and address, Owner's name and address, and Architect's name and phone number.
- B. Pre-Installation Meeting: Conduct a meeting at the project site to discuss installation conditions and requirements; require the attendance of all relevant installers.

1.09 DELIVERY, STORAGE, AND HANDLING:

- A. Deliver and store products until ready for installation in manufacturer's original unopened packaging, legibly marked with manufacturer's name and product identification, date of manufacture, lot number, shelf life, listing agency's classification marking, curing time, and mixing instructions if applicable.
- B. Following manufacturer's instructions, store and handle in such a manner as to prevent deterioration or damage due to moisture, temperature changes, contaminants, and or other causes.
- C. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.10 PROJECT CONDITIONS:

- A. Coordinate construction and cutting of openings so that each particular firestop system may be installed in accordance with its listing, including sizing, sleeves, and penetrating items.
- B. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install firestopping under environmental conditions outside manufacturer's absolute limits.
- C. Provide ventilation as required by firestopping manufacturer, including mechanical ventilation if required.

PART 2 PRODUCTS

2.01 MANUFACTURERS:

- A. Acceptable Manufacturer:

3M Fire Protection Products, Inc
Hilti Fire Stop Products
- B. Single Source: All instances of a specific firestop system shall be made using products of the same manufacturer; where multiple installers (e.g. different subcontractors) are responsible for installation of firestopping, all installers shall use the same system made by the same manufacturer.
- C. Where a proposed system is not listed by one of the listing agencies specified as acceptable, submit evidence prepared by a qualified independent testing agency that the system complies with the requirements.

2.02 MATERIALS:

- A. Rated Assemblies: Provide installed firestopping that limits the spread of fire, heat, smoke, and gasses through otherwise unprotected openings in rated assemblies, including walls, partitions, floors, roof/ceilings, etc.⁴⁵
- B. Provide firestopping that has fire resistance rating equal to or greater than the fire-resistance rating of the assembly in which it is to be installed.

- C. Provide firestopping that has movement capability appropriate to the potential movement of the gap.
- D. Requirements for All Types of Firestopping:

Listing Agency: Provide systems that are listed by at least one the following:

Underwriters Laboratories Inc. (UL), in "Fire Resistance Directory" category XHEZ or XHBN as appropriate.

ITS, in "Directory of Listed Products"

Omega Point Laboratories (OPL), in "Directory of Listed Products, Through Penetration Fire Resistance Directory"

Any other qualified independent testing and inspection agency that conducts periodic follow-up inspections and is acceptable to authorities having jurisdiction.

Furnish products identical to those tested for classification by listing agency.

Mark product packing with classification marking of listing agency.

Unlisted Systems: Where firestop systems not listed by any listing agency are required due to project conditions, submit a substitution proposal with evidence specified.

Firestopping Exposed To View: Provide products with flame spread index of less than 25 and smoke developed index of less than 450, when tested in accordance with ASTM E 84.

Firestopping Exposed to View, Traffic, Moisture, or Physical Damage: Provide products that after curing do not deteriorate when exposed to those conditions during and after construction.

Materials: Use only products specifically listed for use in listed systems.

Compatibility: Provide products that are compatible with each other, with the substrates forming openings, and with the items, if any, penetrating the firestopping, under the conditions represented by this project, based on testing and field performance demonstrated by manufacturer.

- E. Through Penetration Firestop Systems (All Types Except Electrical Penetrations): Provide firestop systems listed for the specific combination of fire rated construction, type of penetrating item, annular space requirements, and fire rating, and:

F-Rating: Provide firestopping that has F-rating equal to or greater than the fire-resistance rating of the assembly in which the firestopping will be installed.

T-Rating: In habitable rooms and areas, where penetrating items are exposed to potential contact with materials on fire side(s) of rated assembly, provide firestopping that has a T-rating equal to its F-rating.

Wall Penetrations: Provide systems that are symmetrical, with the same rating from both sides of the wall.

Cold Smoke Resistance: Provide firestopping that has L-rating of 1 cfm per linear foot (5.5 cu m/h/m), maximum.

Testing: Determine ratings in accordance with ASTM E 814 or UL 1479.

Provide asbestos-free products.

Schedule of Systems: Indicated on the drawings

- F. Through Penetration Firestop System For Electrical Penetrations: Provide firestopping complying with UL system No.5, R11044, tested in accordance with UL 1709, ASTM E 119, ASTM E 1529, and ASTM E 1725.

Smoke and Flame Sealant: 3M FireDam(tm) 150+ Caulk, 3M Fire Barrier CP 25WB+ Caulk, or 3M Fire Barrier IC 15WB Caulk.

Tape for Vapor Barrier, Heat Reflector, and Installation Aid: 3M Interam(tm) T-49 aluminum foil tape

Tape for Installation: Scotch 898 Filament Tape.

Sheet to Cover Openings and as Collar: 3M Fire Barrier CS-195+ Composite Sheet.

Cast In Place Devices: 3M Fire Barrier Cast In Place Devices.

PART 3 EXECUTION:

3.01 EXAMINATION:

- A. Do not begin installation until substrates have been properly prepared.
- B. Conduct tests according to manufacturer's written recommendations to verify that substrates are free of oil, grease, rolling compounds, incompatible primers, loose mill scale, dirt and other foreign substances capable of impairing bond of firestopping.
- C. Verify that items penetrating fire rated assemblies are securely attached, including sleeves, supports, hangers, and clips.
- D. Verify that openings and adjacent areas are not obstructed by construction that would interfere with installation of firestopping, including ducts, piping, equipment, and other suspended construction.
- E. Verify that environmental conditions are safe and suitable for installation of firestopping.
- F. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION:

- A. Prepare substrates in accordance with manufacturer's instructions and recommendations.
- B. Install masking and temporary coverings as required to prevent contamination or defacement of adjacent surfaces due to firestopping installation.

3.03 INSTALLATION:

- A. Install in strict accordance with manufacturer's detailed installation instructions and procedures.

- B. Install so that openings are completely filled and material is securely adhered.
- C. Where firestopping surface will be exposed to view, finish to a smooth, uniform surface flush with adjacent surfaces.
- D. After installation is complete, remove combustible forming materials and accessories that are not part of the listed system.
- E. Repair or replace defective installations to comply with requirements.
- F. At each through penetration, attach identification labels on both sides in location where label will be visible to anyone seeking to remove penetrating items or firestopping.
- G. Clean firestop materials off surfaces adjacent to openings as work progresses, using methods and cleaning materials approved in writing by firestop system manufacturer and which will not damage the surfaces being cleaned.
- H. Notify authority having jurisdiction when firestopping installation is ready for inspection; obtain advance approval of anticipated inspection dates and phasing, if any, required to allow subsequent construction to proceed.
- I. Do not cover firestopping with other construction until approval of authority having jurisdiction has been received.

3.04 PROTECTION:

- A. Protect installed systems and products until completion of project; where subject to traffic, provide adequate protection board.
- B. Touch-up, repair or replace damaged systems and products before Substantial Completion.

END OF SECTION 23 03 00

**SECTION 23 04 00
MECHANICAL INSULATION**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 01 and the following listed sections as a minimum, apply fully to work in this section.

Section 23 00 00 MECHANICAL GENERAL REQUIREMENTS

- B. Refer to and coordinate all work with the work of the following listed sections:

Section 23 00 50 MECHANICAL: ELECTRICAL COMPONENTS

Section 23 02 50 MECHANICAL: PIPE HANGERS AND SUPPORTS
Section 23 03 00 MECHANICAL: FIRE SAFING / FIRESTOPPING

Section 23 10 00 PLUMBING

Section 23 55 00 HVAC: HYDRONIC SYSTEMS

Section 23 56 50 HVAC: REFRIGERANT SYSTEMS

Section 23 80 00 HVAC: AIR HANDLING SYSTEMS

1.02 SCOPE

- A. Provide labor, equipment and materials to complete the work indicated on drawings and herein specified.
- B. Work includes but is not limited to:

Hot Piping systems insulation
Cold Piping systems insulation

Hot Equipment insulation
Cold Equipment insulation

Duct insulation

Condensation (anti sweat) insulation

1.03 RELATED WORK

- A. Work in conjunction with this section shall be as designated below:

General Contractor:

Cutting, Patching, and Painting

Flashing
Openings in walls
Equipment foundations and supports
All temporary heating

1.04 PROJECT ADMINISTRATION

- A. Transmit questions, submissions, notices, and correspondence through the general contractor for transmittal to the Architect.
- B. Prepare and transmit to the Architect all submittal requirements within the time period allowed. See Schedule of Submissions.

1.05 SUBMITTALS

- A. See SUBMITTAL GENERAL REQUIREMENTS within Section 23 00 00.
- B. The following shop drawings shall be prepared and submitted for approval within the time period stated (see SCHEDULE OF SUBMISSIONS in Section 23 00 00): (The list below is not intended to be all-inclusive. Provide submittals for all materials and equipment proposed for use on this project.)

Piping Insulation, All Systems
Duct Insulation, All Systems
Vapor Barrier Materials

- C. General Materials:

A complete list of materials, including manufacturer's descriptive technical literature, performance data, catalog cuts, and installation instructions. The product number, k-value, thickness and furnished accessories for each mechanical system requiring insulation shall be included. Materials furnished under this section of the specification shall be submitted at one time.

Provide a schedule for each system including the following:

Material
Thickness
"k" value
Density
Finish
Jacket

- D. Samples:

Thermal Insulation Materials: After approval of materials, actual sections of installed systems, properly insulated in accordance with the specification requirements, shall be displayed. Such actual sections must remain accessible to inspection throughout the job and will be reviewed from time to time for controlling the quality of the work throughout the construction site. Each material used shall be identified, by indicating on an attached sheet the specification requirement for the material and the material by each manufacturer intended to meet the requirement. The Owner will inspect display sample sections at the jobsite. Approved display sample sections shall remain on display at the jobsite during the construction period. Upon completion of construction, the display sample sections will be closed and sealed.

1.06 SYSTEM DESCRIPTION

A. Field-applied insulation and accessories on mechanical systems shall be as specified herein; factory-applied insulation is specified under the piping, duct or equipment to be insulated.

B. Insulation Systems are as follows:

Anti Sweat	AS
Heat Conservation:	HC
Cold Conservation:	CC
Energy Conservation	EC
Personal Protection:	PP

C. Piping Systems – Insulation systems are as follows:

Domestic cold water	AS/CC
Domestic hot water	HC
Sanitary Vents	AS
Heating hot water	HC
Refrigerant	EC / AS / CC

D. Ductwork – Insulation systems are as follows:

Heating supply ductwork	HC
Fresh air intake ductwork	HC/CC/AS

1.07 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only. At the discretion of the Owner, the manufacturer of any material supplied will be required to furnish test reports pertaining to any of the tests necessary to assure compliance with the standard or standards referenced in this specification.

American Society for Testing And Materials (ASTM)

ASTM C 1136 (1995) Flexible, Low Permeance Vapor Retarders for Thermal Insulation

ASTM C 1290 (2000e1) Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts

ASTM C 195 (1995) Mineral Fiber Thermal Insulating Cement

ASTM C 449/C 449M (2000) Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement

ASTM C 534 (2001a) Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form

ASTM C 553 (2000) Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications

ASTM C 647 (1995; R 2000) Properties and Tests of Mastics and Coating Finishes for Thermal Insulation

ASTM C 916 (1985; R 1996e1) Adhesives for Duct Thermal Insulation

ASTM C 920 (2002) Elastomeric Joint Sealants

ASTM C 921 (1989; R 1996) Determining the Properties of Jacketing Materials for Thermal Insulation

ASTM D 882 (1997) Tensile Properties of Thin Plastic Sheeting

ASTM E 84 (2001) Surface Burning Characteristics of Building Materials

ASTM E 96 (2000e1) Water Vapor Transmission of Materials

1.08 GENERAL QUALITY CONTROL

A. Standard Products:

Materials shall be the standard products of manufacturers regularly engaged in the manufacture of such products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

B. Installer's Qualifications:

Qualified installers shall have successfully completed three or more similar type jobs within the last 5 years.

C. Surface-Burning Characteristics:

Unless otherwise specified, insulation not covered with a jacket shall have a flame spread index no higher than 75 and a smoke developed index no higher than 150. Insulation systems which are located in air plenums, in ceiling spaces, and in attic spaces shall have a flame spread index no higher than 25 and a smoke developed index no higher than 50. Insulation materials located exterior to the building perimeter are not required to be fire-rated. Flame spread, and smoke developed indexes, shall be determined by ASTM E 84. Insulation shall be tested in the same density and installed thickness as the material to be used in the actual construction. Material supplied by a manufacturer with a jacket shall be tested as a composite material. Jackets, facings, and adhesives shall have a flame spread index no higher than 25 and a smoke developed index no higher than 50 when tested in accordance with ASTM E 84.

D. Identification of Materials:

Packages or standard containers of insulation, jacket material, cements, adhesives, and coatings delivered for use, and samples required for approval shall have manufacturer's stamp or label attached giving the name of the manufacturer and brand, and a description of the material.

1.09 STORAGE

- A. Materials shall be delivered in the manufacturer's unopened containers. Materials delivered and placed in storage shall be provided with protection from weather, humidity, dirt, dust and other contaminants. The Owner may reject insulation material and supplies that become dirty, dusty, wet, or contaminated by some other means.

PART 2 PRODUCTS GENERAL

2.01 GENERAL MATERIALS

- A. Materials shall be compatible and shall not contribute to corrosion, soften, or otherwise attack surfaces to which applied in either the wet or dry state. Materials to be used on stainless steel surfaces shall meet ASTM C 795 requirements. Materials shall be asbestos free and conform to the following:

- B. Acoustical Lining Insulation Adhesive

Adhesive shall be a nonflammable, fire-resistant adhesive conforming to ASTM C 916, Type I.

- C. Mineral Fiber Insulation Cement

Cement shall be in accordance with ASTM C 195.

- D. Lagging Adhesive

Lagging is the material used for thermal insulation, especially around a cylindrical object. This may include the insulation as well as the cloth/material covering the insulation. Lagging adhesives shall be nonflammable and fire-resistant and shall have a flame spread rating no higher than 25 and a smoke developed rating no higher than 50 when tested in accordance with ASTM E 84. Adhesive shall be pigmented white and be suitable for bonding fibrous glass cloth to faced and unfaced fibrous glass insulation board; for bonding cotton brattice cloth to faced and unfaced fibrous glass insulation board; for sealing edges of and bonding fibrous glass tape to joints of fibrous glass board; for bonding lagging cloth to thermal insulation; or for attaching fibrous glass insulation to metal surfaces. Lagging adhesives shall be applied in strict accordance with the manufacturer's recommendations.

- E. Contact Adhesive

Adhesives may be dispersed in a volatile organic solvent. Adhesives may be any of, but not limited to, the neoprane based, rubber based, or elastomeric type that have a flame spread index no higher than 25 and a smoke developed index no higher than 50 when tested in the dry state in accordance with ASTM E 84. The adhesive shall not adversely affect, initially or in service, the insulation to which it is applied, nor shall it cause any corrosive effect on metal to which it is applied. Any solvent dispersing medium or volatile component of the adhesive shall have no objectionable odor and shall not contain any benzene or carbon tetrachloride. The dried adhesive shall not emit nauseous, irritating, or toxic volatile matters or aerosols when the adhesive is heated to any temperature up to 212 degrees F. The dried adhesive shall be nonflammable and fire resistant. Natural cross-ventilation, local (mechanical) pickup, and/or general area (mechanical) ventilation shall be used to prevent an accumulation of solvent vapors, keeping in mind the ventilation pattern must remove any heavier-than-air solvent vapors from lower levels of the workspaces. Gloves and spectacle-type safety glasses are recommended in accordance with safe installation practices.

F. Caulking

ASTM C 920, Type S, Grade NS, Class 25, Use A.

G. Corner Angles

Nominal 0.016 inch aluminum 1 x 1 inch with factory applied kraft backing. Aluminum shall be ASTM B 209, Alloy 3003, 3105, or 5005.

H. Finishing Cement

ASTM C 449/C 449M: Mineral fiber hydraulic-setting thermal insulating and finishing cement. All cements that may come in contact with Austenitic stainless steel must include testing per ASTM C 795.

I. Fibrous Glass Cloth and Glass Tape

Fibrous glass cloth and glass tape shall have flame spread and smoke developed ratings of no greater than 25/50 when measured in accordance with ASTM E 84. Tape shall be 4 inch wide rolls.

J. Staples

Outward clinching type ASTM A 167, Type 304 or 316 stainless steel. Monel is a nickel rich alloy that has high strength, high ductility, and excellent resistance to corrosion.

K. Jackets

ASTM C 921, Type I, maximum moisture vapor transmission 0.02 perms, (measured before factory application or installation), minimum puncture resistance 50 Beach units on all surfaces where a minimum puncture resistance of 25 Beach units is acceptable. Minimum tensile strength, 35 pounds/inch width. ASTM C 921, Type II, minimum puncture resistance 25 Beach units, tensile strength minimum 20 pounds/inch width. Jackets used on insulation exposed in finished areas shall have white finish suitable for painting without sizing. Based on the application, insulation materials that require factory applied jackets are mineral fiber, cellular glass, and phenolic foam. All non-metallic jackets shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E 84.

L. White Vapor Retarder All Service Jacket (ASJ)

For use on hot/cold pipes, ducts, or equipment vapor retarder jackets used on insulation exposed in finished areas shall have white finish suitable for painting without sizing.

M. Aluminum Jackets

Aluminum jackets shall be corrugated, embossed or smooth sheet, 0.016 inch nominal thickness; ASTM B 209, Temper H14, Temper H16, Alloy 3003, 5005, or 3105 with factory applied moisture retarder. Corrugated aluminum jacket shall not be used outdoors. aluminum jacket securing bands shall be Type 304 stainless steel, 0.015 inch thick, 1/2 inch wide for pipe under 12 inch diameter and 3/4 inch wide for pipe over 12 inch and larger diameter. Aluminum jacket circumferential seam bands shall be 2 x 0.016 inch aluminum matching jacket material. Bands for insulation below ground shall be 3/4 x 0.020 inch thick stainless steel, or fiberglass reinforced tape. The jacket may, at the option of the Contractor, be provided with a factory fabricated Pittsburgh or "Z" type longitudinal joint. When the "Z" joint is used, the bands at the circumferential joints shall be designed by the manufacturer to seal the joints and hold the jacket in place.

N. Polyvinyl Chloride (PVC) Jackets

Polyvinyl chloride (PVC) jacket and fitting covers shall have high impact strength, UV resistant rating or treatment and moderate chemical resistance with minimum thickness 0.030 inch.

O. Vapor Retarder Mastic Coatings

The vapor retarder coating shall be fire and water resistant and appropriately selected for either outdoor or indoor service. Color shall be white. The water vapor permeance of the compound shall be determined according to procedure B of ASTM E 96 utilizing apparatus described in ASTM E 96. The coating shall be a nonflammable, fire resistant type. All other application and service properties shall be in accordance with ASTM C 647.

P. Laminated Film Vapor Retarder

ASTM C 1136, Type I, maximum moisture vapor transmission 0.02 perms, minimum puncture resistance 50 Beach units on all surfaces except concealed ductwork, where Type II, maximum moisture vapor transmission 0.02 perms, a minimum puncture resistance of 25 Beach units is acceptable.

Q. Polyvinylidene Chloride (PVDC) Film Vapor Retarder

The PVDC film vapor retarder shall have a maximum moisture vapor transmission of 0.02 perms, minimum puncture resistance of 150 Beach units, a minimum tensile strength in any direction of 30 lb/inch when tested per ASTM D 882, and a maximum flame spread/smoke developed index of 25/50 per ASTM E 84.

R. Polyvinylidene Chloride Vapor Retarder Adhesive Tape

Requirements must meet the same as specified for PVDC Film Vapor Retarder in paragraph above.

S. Non-Vapor Retarder Mastic Coatings

ASTM C 1136, Type III, maximum moisture vapor transmission 0.10 perms, minimum puncture resistance 50 Beach units on all surfaces except ductwork, where Type IV, maximum moisture vapor transmission 0.10, a minimum puncture resistance of 25 Beach units is acceptable.

T. Wire

Soft annealed ASTM A 580/A 580M Type 302, 304 or 316 stainless steel, 16 or 18 gauge.

U. Sealants

Sealants shall be chosen from the butyl polymer type, the styrene-butadiene rubber type, or the butyl type of sealants. Sealants shall have a maximum moisture vapor transmission of 0.02 perms, and a maximum flame spread/smoke developed index of 25/50 per ASTM E 84.

PART 3 INSULATION SYSTEMS: PIPING

3.01 INSULATION: GENERAL

- A. Install insulation in a neat and workmanlike manner, observing the best practices of the trade. Longitudinal seams shall be flat and face structure away from view. Insulation shall be smooth throughout. No raw ends of insulation will be permitted; cover raw ends with caps.

3.02 INSULATION SYSTEM: DOMESTIC WATER PIPING

- A. Scope / Insulation System:

Domestic Cold Water	CC / AS
Domestic Hot Water	HC
Domestic Hot Water Recirculating	HC

- B. Materials: Provide one piece insulation of long, fine flame attenuated glass fibers, covered with factory applied all purpose jacket of white kraft bonded to aluminum foil and reinforced with fiberglass yarn.

Flame spread:	25
Smoke developed:	50
Conductivity:	.24 at 100 degree F (mean)

- C. Fittings and valves shall be covered with similar material, of same thickness, as pipe covering with vapor seal and PVC premolded plastic jacket.

- D. Workmanship: Apply pipe insulation over clean, dry surfaces, with adjoining sections firmly together. Insulate flanges, valves and fittings with mitered segments of pipe insulation of equal thickness. Fittings on 2" and smaller pipe may be insulated with insulating cement of equal thickness. Insulation and vapor barrier shall pass uninterrupted through all hangers, supports and pipe sleeves.

INSULATION THICKNESS SCHEDULE

Pipe Size:	<u>1/2" thru 1-1/4"</u>	<u>1-1/2" thru 3"</u>	<u>4" and larger</u>
Pipe Use:			
Hot Water & HW Recirc.	1"	1.5"	2"
Cold Water	1/2"	1"	1-1/2"

- E. Scope: All domestic water system piping. Premolded PVC coverings on exposed piping only.

3.03 PVC Fitting Covers

- A. Provide PVC premolded, one piece, high impact covers with fiberglass inserts and accessories for elbows tees, valves, caps, couplings, specialties, etc.

Surface burning characteristics	25 Flame 50 Smoke
UL Listed 94V-0	
Insert thermal conductivity	.26K @ 75°F

- B. Installation: Fiberglass insert shall be wrapped completely around the fitting or snugly positioned inside the PVC Cover for proper fit. The Cover shall be applied over the fitting and insert, and the throat secured by tack fastening, taping, sealing with a solvent type PVC adhesive, or banding.
- C. Cold Pipe: Fitting systems below ambient temperature shall be with a continuous vapor barrier, with PVC Tape, PVC Adhesive, or a vapor barrier mastic as specified by the engineer. When using PVC Tape, use a 2" minimum downward overlap. Care should be taken not to stretch the last 2" of PVC Tape, to avoid stretching or creeping.
- D. Scope: Provide pre-molded PVC coverings on exposed piping only.

3.04 PVC INSULATION JACKET

- A. All piping exposed to view within occupied spaces shall be fit with insulation faced with a white, PVC exterior jacket. Piping insulation within mechanical spaces does not require PVC jacketing.
- B. The jacketing shall be installed such that it extends into all wall sleeves, out of view, past escutcheons. All seams shall be continuously cemented and arranged such that they are out of view. Jacketing for pipe insulation shall be Zeston 2000 PVC jacketing, 20 mils thick, white to match fitting covers. Jacket shall be ASTM E84 rated 25/50. Manufacturer shall provide Zeston Perma-Weld solvent welding adhesive to seal PVC lap joints.

3.05 INSULATION SYSTEM: SANITARY VENTS THROUGH ROOF

- A. Requirements: Sanitary Vents Through Roof AS
- B. Scope: All interior sanitary vent at location of roof penetrations. Insulation shall extend 4'-0" from underside of roof deck minimum.
- C. Material: Lightweight blanket type insulation of long, fine flame attenuated glass fibers, bonded with a thermo-setting resin.
- D. Insulation shall be as manufactured by Certain-Teed Corporation, Knauf, or Owens - Corning.

Conductivity: .27 at 100 Degrees Fahrenheit
Density: 75 lbs. per cu. ft.
Facing: 0.004" thick, class 1 pigmented vinyl
Fire Hazard Classification: 25/50

Thickness: 1 ½"

3.06 INSULATION SYSTEM: REFRIGERATION PIPING

- A. Service / Insulation System: Refrigerant Liquid CC / AS
Refrigerant Suction CC / AS
- B. Material: Tubular close-celled, foamed plastic material:

Fire Rating: Self extinguishing
Conductivity: .26 at 70 deg F mean

- C. Insulation shall be as manufactured by John-Mansville, Owens Corning, Certain-Teed or approved equal.
- D. Workmanship: Slip tube insulation over open ends of piping during installation. Cover fittings with same material mitered and cemented to suit. At pipe hanger provide rigid insulation block. Only with approval of the Architect shall insulation be slit and snapped over pipe. Insulation and vapor barrier shall pass uninterrupted through all hangers, supports and pipe sleeves.
- E. Thickness: Nominal 1/2" thick.
- F. Scope: All refrigerant piping (liquid and suction) and appurtenances.

3.07 INSULATION: HOT WATER SYSTEM PIPING: (Domestic Hot Water Heating Systems)

- A. Service / Insulation System:

Hot Water Supply	HC
Hot Water Return	HC
- B. Materials: One piece piping insulation of long, fine, flame attenuated glass fibers, covered with factory applied all purpose jacket of white kraft bonded to aluminum foil and reinforced with fiberglass yarn.

Flame spread: 25
 Smoke developed: 50
 Conductivity: .25 at 100 deg mean

- C. Insulation shall be as manufactured by Johns-Manville, Owens Corning, Certain-Teed, or approved equal.
- D. Workmanship: Insulation shall be applied over clean, dry surfaces, with adjoining sections butting firmly together. Flanges, valves, and fittings shall be insulated with fabricated mitered segments of pipe insulation, equal in thickness to the insulation of the adjoining pipe. Fittings on pipe sized 3 inch and smaller may be insulated with a submitted and approved insulating cement of equal thickness. Insulation and vapor barrier shall pass uninterrupted through all hangers, supports and pipe sleeves.
- E. Thickness: Install insulation thickness as follows:

SCHEDULE OF INSULATION THICKNESS

Type of Piping	Pipe Size (inches)	
	<u>1/2 to 1-1/4"</u>	<u>1-1/2" and larger</u>
Supply and Return	1.5"	2.0"

- F. Scope: All hot water system piping and make up piping including pumps and other in-line appurtenances. Provide pre-molded PVC Fitting Covers on all exposed fittings.

PART 4 INSULATION SYSTEMS DUCTWORK

4.01 INSULATION: DUCT / BLANKET TYPE:

- A. Service / Insulation System:
- | | |
|---|---------|
| Conditioned Supply Air, Heating & Cooling | CC / AS |
| Conditioned Return Air, Heating & Cooling | CC / AS |
| Ventilation Supply Air | CC / AS |
| Ventilation Exhaust Air | CC / AS |
| Fresh Air Intake Ductwork | HC / AS |
- B. Material: Lightweight blanket type insulation of long, fine flame attenuated glass fibers, bonded with a thermo-setting resin.
- C. Insulation shall be as manufactured by Certain-Teed Corporation, Knauf, or Owens-Corning.
- | | |
|-----------------------------|---------------------------------------|
| Conductivity: | .27 at 100 Degrees Fahrenheit |
| Density: | 75 lbs. per cu. ft. |
| Facing: | 0.004" thick, class 1 pigmented vinyl |
| Fire Hazard Classification: | 25/50 |
- D. Workmanship: Blanket insulation shall be applied in a neat, workmanlike manner and shall be securely fastened to the ductwork with No. 104 adhesive, as manufactured by The Minnesota Mining Company or an approved equal.
- E. Longitudinal joints shall be lapped and stitched with staples. Joints shall be away from view where possible. Circumferential joints shall be lapped and taped or lapped and cemented with approved materials.
- R-value (ft²·°F·hr/Btu): R-8 unless otherwise noted
R-12 in all spaces outside of building insulation envelope as required by the RI amendments to the International mechanical code/
- F. Scope: All concealed supply, return, fresh air intake ductwork & ERV supply/exhaust ductwork.

PART 5 EXECUTION

5.01 GENERAL:

A. Installation:

Insulation shall only be applied to non-operating, unheated and uncooled piping and equipment. Flexible elastomeric cellular insulation shall not be compressed at joists, studs, columns, ducts, hangers, etc. The insulation shall not pull apart after a one hour period; any insulation found to pull apart after one hour, shall be replaced.

Except as otherwise specified, material shall be installed in accordance with the manufacturer's written instructions. Insulation materials shall not be applied until tests specified in other sections of this specification are completed. Material such as rust, scale, dirt and moisture shall be removed from surfaces to receive insulation. Insulation shall be kept clean and dry. Insulation shall not be removed from its shipping containers until the day it is ready to use and shall be returned to like containers or equally protected from dirt and moisture at the end of each workday. Insulation that becomes dirty shall be thoroughly cleaned prior to use. If insulation becomes wet or if cleaning does not restore the surfaces to like new condition, the insulation will be rejected, and shall be immediately removed from the job site. Joints shall be staggered on multi layer insulation.

Mineral fiber thermal insulating cement shall be mixed with demineralized water when used on stainless steel surfaces. Insulation, jacketing and accessories shall be installed in accordance with MICA Insulation Stds plates except where modified herein or on the drawings.

B. Fire-Stopping:

Where pipes and ducts pass through firewalls, fire partitions, above grade floors, and fire rated chase walls, the penetration shall be sealed with fire stopping materials.

C. Painting and Finishing:

Painting shall be as directed by the Owner or to match existing requirements.

D. Installation of Flexible Elastomeric Cellular Insulation

Flexible elastomeric cellular insulation shall be installed with seams and joints sealed with rubberized contact adhesive. Insulation with pre-applied adhesive is not permitted. Flexible elastomeric cellular insulation shall not be used on surfaces greater than 200 degrees F. Seams shall be staggered when applying multiple layers of insulation. Insulation exposed to weather and not shown to have jacketing shall be protected with two coats of UV resistant finish as recommended by the manufacturer after the adhesive is dry. A brush coating of adhesive shall be applied to both butt ends to be joined and to both slit surfaces to be sealed. The adhesive shall be allowed to set until dry to touch but tacky under slight pressure before joining the surfaces. Insulation seals at seams and joints shall not be capable of being pulled apart one hour after application. Insulation that can be pulled apart one hour after installation shall be replaced.

E. Pipes / Ducts / Equipment which require Insulation:

Insulation is required on all pipes, ducts, or equipment, unless specifically noted otherwise.

5.02 PIPE INSULATION INSTALLATION

A. General:

Pipe insulation shall be installed on aboveground hot and cold pipeline systems as specified below to form a continuous thermal retarder, including straight runs, fittings and appurtenances unless specified otherwise. Installation shall be with full-length units of insulation and using a single cut piece to complete a run. Cut pieces or scraps abutting each other shall not be used.

Pipe insulation shall be omitted on the following:

Pipe used solely for fire protection.

Chromium plated pipe to plumbing fixtures. However, fixtures for use by the physically handicapped shall have the hot water supply and drain, including the trap, insulated where exposed.

Sanitary drain lines.

Air chambers.

B. Pipes Passing Through Walls, Roofs, and Floors

Pipe insulation shall be continuous through the sleeve.

An aluminum jacket with factory applied moisture retarder shall be provided over the insulation wherever penetrations require sealing.

Where pipes penetrate interior walls, the aluminum jacket shall extend 2 inches beyond either side of the wall and shall be secured on each end with a band.

Where penetrating floors, the aluminum jacket shall extend from a point below the backup material to a point 10 inches above the floor with one band at the floor and one not more than 1 inch from the end of the aluminum jacket.

Where penetrating waterproofed floors, the aluminum jacket shall extend from below the backup material to a point 2 inches above the flashing with a band 1 inch from the end of the aluminum jacket.

Where penetrating exterior walls, the aluminum jacket required for pipe exposed to weather shall continue through the sleeve to a point 2 inches beyond the interior surface of the wall.

Where penetrating roofs, pipe shall be insulated as required for interior service to a point flush with the top of the flashing and sealed with vapor retarder coating. The insulation for exterior application shall butt tightly to the top of flashing and interior insulation. The exterior aluminum jacket shall extend 2 inches down beyond the end of the insulation to form a counter flashing. The flashing and counter flashing shall be sealed underneath with caulking.

C. Pipes Passing Through Hangers:

Insulation, whether hot or cold application, shall be continuous through hangers. All horizontal pipes 2 inches and smaller shall be supported on hangers with the addition of a Type 40 protection shield to protect the insulation in accordance with MSS SP-69. Whenever insulation shows signs of being compressed, or when the insulation or jacket shows visible signs of distortion at or near the support shield, insulation inserts as specified below for piping larger than 2 inches shall be installed.

Horizontal pipes larger than 2 inches at 60 degrees F and above shall be supported on hangers in accordance with MSS SP-69.

Horizontal pipes larger than 2 inches and below 60 degrees F shall be supported on hangers with the addition of a Type 40 protection shield in accordance with MSS SP-69. An insulation insert of cellular glass, calcium silicate (or perlite above 80 F) or the necessary strength polyisocyanurate, shall be installed above each shield. The insert shall cover not less than the bottom 180-degree arc of the pipe. Inserts shall be the same thickness as the insulation, and shall extend 2 inches on each end beyond the protection shield. When insulation inserts are required per the above, and the insulation thickness is less than 1 inch, wooden or cork dowels or blocks may be installed between the pipe and the shield to prevent the weight of the pipe from crushing the insulation, as an option to installing insulation inserts. The insulation jacket shall be continuous over the wooden dowel, wooden block, or insulation insert.

5.03 DUCT INSULATION INSTALLATION

A. Installation through Sleeves and at Fire Dampers:

Duct insulation shall be continuous through sleeves and prepared openings except firewall penetrations. Duct insulation terminating at fire dampers, shall be continuous over the damper collar and retaining angle of fire dampers, which are exposed to unconditioned air and which may be prone to condensate formation. Duct insulation and vapor retarder shall cover the collar, neck,

and any non-insulated surfaces of diffusers, registers and grills. Vapor retarder materials shall be applied to form a complete unbroken vapor seal over the insulation.

B. Installation on Concealed Ductwork:

For rectangular, oval or round ducts, insulation shall be attached by applying adhesive around the entire perimeter of the duct in 6-inch wide strips on 12 inch centers.

For rectangular and oval ducts, 24 inches and larger insulation shall be additionally secured to bottom of ducts by the use of mechanical fasteners. Fasteners shall be spaced on 16 inch centers and not more than 16 inches from duct corners.

For rectangular, oval and round ducts, mechanical fasteners shall be provided on sides of duct risers for all duct sizes. Fasteners shall be spaced on 16-inch centers and not more than 16 inches from duct corners.

Insulation shall be impaled on the mechanical fasteners (self stick pins) where used and shall be pressed thoroughly into the adhesive. Care shall be taken to ensure vapor retarder jacket joints overlap 2 inches. The insulation shall not be compressed to a thickness less than that specified. Insulation shall be carried over standing seams and trapeze-type duct hangers.

Self-locking washers shall be installed where mechanical fasteners are used. The pin shall be trimmed back and bent over.

Jacket overlaps shall be secured with staples and tape as necessary to ensure a secure seal. Staples, tape and seams shall be coated with a brush coat of vapor retarder coating or PVDC adhesive tape.

Breaks in the jacket material shall be covered with patches of the same material as the vapor retarder jacket. The patches shall extend not less than 2 inches beyond the break or penetration in all directions and shall be secured with tape and staples. Staples and tape joints shall be sealed with a brush coat of vapor retarder coating or PVDC adhesive tape.

At jacket penetrations such as hangers, thermometers, and damper operating rods, voids in the insulation shall be filled and the penetration sealed with a brush coat of vapor retarder coating or PVDC adhesive tape.

Insulation terminations and pin punctures shall be sealed and flashed with a reinforced vapor retarder coating finish or tape with a brush coat of vapor retarder coating. The coating shall overlap the adjoining insulation and non-insulated surface 2 inches. Pin puncture coatings shall extend 2 inches from the puncture in all directions.

Where insulation standoff brackets occur, insulation shall be extended under the bracket and the jacket terminated at the bracket.

C. Installation on Exposed Ductwork:

For rectangular ducts, rigid insulation shall be secured to the duct by mechanical fasteners on all four sides of the duct, spaced not more than 12 inches apart and not more than 3 inches from the edges of the insulation joints. A minimum of two rows of fasteners shall be provided for each side of duct 12 inches and larger. One row shall be provided for each side of duct less than 12 inches.

Duct insulation shall be formed with minimum jacket seams. Each piece of rigid insulation shall be fastened to the duct using mechanical fasteners. When the height of projections is less than the insulation thickness, insulation shall be brought up to standing seams, reinforcing, and other vertical projections and shall not be carried over. Vapor retarder jacket shall be continuous across

seams, reinforcing, and projections. When height of projections is greater than the insulation thickness, insulation and jacket shall be carried over. Insulation shall be impaled on the fasteners; self-locking washers shall be installed and the pin trimmed or bent over.

Joints in the insulation jacket shall be sealed with a 4-inch wide strip of tape. Tape seams shall be sealed with a brush coat of vapor retarder coating.

Breaks and ribs or standing seam penetrations in the jacket material shall be covered with a patch of the same material as the jacket. Patches shall extend not less than 2 inches beyond the break or penetration and shall be secured with tape and stapled. Staples and joints shall be sealed with a brush coat of vapor retarder coating.

At jacket penetrations such as hangers, thermometers, and damper operating rods, the voids in the insulation shall be filled and the penetrations sealed with a brush coat of vapor retarder coating.

Insulation terminations and pin punctures shall be sealed and flashed with a reinforced vapor retarder coating finish. The coating shall overlap the adjoining insulation and non-insulated surface 2 inches. Pin puncture coatings shall extend 2 inches from the puncture in all directions.

Oval and round ducts, flexible type, shall be insulated with factory Type I jacket insulation with minimum density of 3/4 pcf, attached as per MICA standards.

Retarder coating shall be applied over insulation, including removable sections, with a layer of open mesh synthetic fabric embedded between the coats. The total dry thickness of the finish shall be 1/16 inch. Caulking shall be applied to parting line between equipment and removable section insulation.

END OF SECTION 23 04 00

SECTION 23 04 40
MECHANICAL: PIPE CLEANING AND TESTING

PART 1 GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 01 and the following listed sections as a minimum, apply fully to work in this section.

Section 23 00 00 MECHANICAL GENERAL REQUIREMENTS

- B. Refer to and coordinate all work with the work of the following listed Sections:

Section 23 10 00 PLUMBING
Section 23 15 00 PLUMBING: FIXTURES

Section 23 30 00 FIRE PROTECTION

Section 23 55 00 HVAC: HYDRONIC SYSTEMS

Section 23 56 50 HVAC: REFRIGERANT SYSTEMS

Section 23 57 00 HVAC: NATURAL GAS PIPING

1.02 SCOPE:

- A. Provide labor, equipment and materials to complete the work indicated on drawings and herein specified.
- B. This specification defines the requirements and procedures for field pressure testing of above ground and underground piping systems, connected equipment and integral components to assure mechanical strength and tightness. Also included are flushing and cleaning requirements for open and/or closed piping systems. Any deviation from this specification shall require written approval from the Engineer.
- C. Testing Exclusions: The following are excluded from the testing requirements of this specification:

Any package unit previously tested by the manufacturer in accordance with the applicable codes.

Any piping specialties, accessories, and equipment including relief valves, traps, orifice plates, instruments and filters.

Piping systems, which are tested in accordance with the applicable building and fire codes and the requirements of those codes are in excess of that required herein.

Lines and systems open to the atmosphere such as safety valve discharges, vents or drains downstream of the last shutoff valve. These lines shall be visually inspected to determine that all joints are properly made up.

1.03 RELATED WORK:

- A. Work in conjunction with this section shall be as designated below:

General Contractor:

Cutting, Patching, and Painting
Openings in roofs
Openings in walls
All temporary heating

Electrical Contractor:

Power wiring for electrical equipment provided within this section.

1.04 PROJECT ADMINISTRATION:

- A. Transmit questions, submissions, notices, and correspondence through the general contractor for transmittal to the Architect.
- B. Prepare and transmit to the Architect all submittal requirements within the time period allowed. See Schedule of Submissions.

1.05 SUBMITTALS:

- A. See SUBMITTAL GENERAL REQUIREMENTS within Section 23 00 00.
- B. The following submittals shall be prepared and submitted for approval within the time period stated (see SCHEDULE OF SUBMISSIONS in Section 23 00 00): (The list below is not intended to be all-inclusive. Provide submittals for all materials and equipment proposed for use on this project.)

Sources of All Cleaning and Testing Agents
Pressures and Temperatures for Final Testing
Date of Test for Each System
Name and Address of Testing and Cleaning Contractor / Contractors
Test pressures and holding time
Calibration record of pressure measuring devices and relief devices settings
Cleaning and Testing Materials to be used with Recommended Temperatures

Means of disposal of flushing, testing and cleaning solutions. *(The Contractor shall contain and legally dispose of all cleaning and testing solutions.)*

Summary report of testing and cleaning results, including testing log for all systems, chemical treatment solutions in place and chemical analysis of system water after testing and cleaning procedures are complete.

1.06 QUALIFICATIONS:

- A. Qualified Contractors shall be recognized as firms specializing in providing services related to the requirements of this specification. All Contractors providing Pipe Cleaning and Testing Services shall have a minimum of three years of documented experience.

1.07 PROJECT CLOSEOUT:

- A. Review and provide closeout requirements of this section and Section 23 00 00 Mechanical General Requirements.

PART 2 PRODUCTS

2.01 CLEANING PRODUCTS:

- A. Liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products.
- B. Cleaning and rinsing solutions for Specialized Piping Systems applied as recommended by manufacturer.
- C. Combined Chelant solution system for passivation of Specialized Piping Systems. Application shall follow the recommendations of specialized Contractor.

2.02 PIPE CLASS TABLE:

PIPE CLASS	PIPE MATERIALS	NOTES:
	<u>Copper and brass</u>	
U2	Copper Tubing Type L	Soldered Joints
U3	Copper Tubing Type K	Soldered Joints
U4	Copper Tubing ACR	Brazed Joints
	<u>Steel</u>	
F1	Carbon Steel Sch 40	Screw, Grooved, Welded
F11	Carbon Steel	Propane / Natural Gas
	<u>Special Tubing and Hoses</u>	
H1	Plastic Tubing	PEX
	<u>Plastic</u>	
P1	PVC drainage	Solvent joints
P2	PVC Sewer	Tyton fittings
P3	PVC Sch 40	Pressure systems

2.03 CLEANING CLASS:

A. Cleaning Class C1:

Covers water flushing and cleaning of piping systems after assembly and erection. Cleaning shall be accomplished by thoroughly flushing with clear water at sufficient velocity to remove all foreign matter.

B. Cleaning Class C2:

Covers the blowing-out of piping systems after assembly and erection. Blow out agent shall be steam (S), oil free air (A), or nitrogen (N)

C. Cleaning Class C3:

Covers water flushing and disinfecting of above and below ground potable water piping systems after assembly and erection. Cleaning of piping shall be accomplished by first thoroughly flushing with potable water at sufficient velocity (2.5 fps mm.) to remove all foreign matter and then sterilizing with chlorine solution (100 ppm of available chlorine for a minimum contact time of 2 hours).

2.04 TESTING CLASS:

A. Testing Class T1:

Covers initial service leak testing per ASME B31 .3, Category D, at operating pressure and leak test inspection of piping systems after assembly and erection.

B. Testing Class T2:

Covers hydrostatic leak and pressure testing and inspection of piping systems after assembly and erection.

C. Testing Class T3:

Covers pneumatic leak and pressure testing and inspection of piping systems after assembly and erection. Pneumatic agent shall be oil free air, or nitrogen (N).

Medical grade breathing air shall be used as the test medium for Specialized Piping and Tubing Systems.

D. Testing Class T4:

Covers static head leak test and test inspection of piping systems after assembly and erection. Piping systems are to be tested and inspected for leak tightness while being subjected to the internal test pressure of a 10 foot static head. Water shall stand in the system without change in level for a period of not less than 5 hours.

2.05 REFERENCES

- A. Piping tests shall comply with the provisions of the latest edition of ASME B31 .3 Process Piping, section 345, Testing. Any conflict between Code and Specification shall be referred to the Engineer for resolution.
- B. Piping cleaning/disinfecting of piping systems shall comply with the provisions of the current edition of the Uniform Plumbing Code, ANSI A40.8 Section 10.9 or AWWA C601. Any conflict between Code (5) and Specification shall be referred to the Engineer for resolution.
- C. The maximum test pressure for each line shall be as per ASME B31 .3 Process Piping, section 345, Testing.

2.06 PIPING SYSTEMS: CLEANING AND TESTING:

<u>PIPE SYSTEM</u>	SYMBOL	PIPE CLASS	CLEANING CLASS	TESTING CLASS	TEST PRESSURE
PLUMBING:					
Cold Water - Domestic Potable	CW	U2	C3	T2	125 psig
Hot Water - Domestic Potable	HW	U2	C3	T2	125 psig
Hot Water Recirculating	HWR	U2	C3	T2	125 psig
Sanitary Waste - PVC	SAN	P1	C1	T4	10ft wc
Sanitary Vent - PVC	V	P1	C1	T4	10ft wc
Storm Drain - PVC	SD	P1	C1	T4	10ft wc
Water Service	W	U4	C3	T2	1.5 x max
Natural Gas (within bldg)	G	F1	C2(A)	T3	10 psig
Force Main PVC	FM	P4	C1	T2	1.5 x max
Pump Discharge - PVC	PD	P4	C1	T2	1.5 x max
FIRE PROTECTION SYSTEMS					
Wet Sprinkler System	F	F1	C1	T2	per NFPA
Wet Sprinkler System - plastic	F	P5	C2(A)	T3	per NFPA
HVAC SYSTEMS					
Heating Hot Water Supply	HWS	F1/U2	C1	T2	1.5 x max, 80# minimum
Heating Hot Water Return	HWR	F1/U2	C1	T2	1.5 x max, 80# minimum
Drain AC Condensate	D	U2	C1	T4	10ft wc
Refrigerant Liquid	DX	U4	C2(N)	T3(N)	1.5 x max
Refrigerant Suction	DX	U4	C2(N)	T3(N)	1.5 x max

2.07 CLEANING PRODUCTS:

- A. Liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products.

PART 3 EXECUTION

3.01 PRESSURE TESTING: GENERAL REQUIREMENTS FOR TESTING

- A. Upon completion of system(s) erection work and cleaning, but prior to adjusting and balancing, all installed piping and/or tubing shall be pressure tested except where otherwise qualified in this specification.
- B. Piping that is to be chemically cleaned after installation shall be tested and all repairs made before cleaning.
- C. Contractor shall provide competent personnel to conduct all tests. System(s) shall not be considered complete until all tests have been concluded to the satisfaction of the Engineer. In the event of leakage or defects, tests must be repeated until all faults are corrected.
- D. Contractor shall furnish all instruments, ladders, test equipment, test tees, accessories, and personnel required for the tests.
- E. All successful tests shall be documented and certified by the General Contractor with the resulting data transmitted to the Architect, to be retained as a permanent record.
- F. Tests shall be considered satisfactory if no leakage is detected on the piping and any of the joints. After this initial period, pressure shall be maintained until system is inspected for leaks and thereafter, for specified time periods according to system tested.

Areas requiring repairs shall be retested as originally specified.

- G. Following the completion and approval of the test, Contractor shall restore all components of the system to normal operating condition. This includes removing the temporary provisions installed for the test.
- H. Piping shall be tested at metal temperatures between 60°F and 100°F.
- I. Hydrotest equipment shall include at least one NIST standard calibrated pressure measuring device (to be installed at the highest point in the tested system) and a calibrated pressure relieving device.
- J. The following shall be excluded from all pressure tests:

Pumps and compressors

Equipment and vendor furnished piping specifically recommended by the manufacturer not to be tested.

3.02 APPLICATION: TEST METHODS AND PRESSURES

- A. Hydrostatic Testing of Piping Designed for Internal Pressure

The hydrostatic test pressure shall not be less than 1.5 times the design pressure.

If the design conditions of piping attached to a vessel are the same as those of the vessel, then the piping and vessel may be tested together at the test pressure of the vessel. However, if the piping should be subject to higher design conditions and requires a higher test than the connected equipment, or if the piping is designed for lesser operating conditions than the connected

equipment and could be overstressed by a system test, then it shall be isolated and tested separately.

B. Pneumatic Testing

If the piping is tested pneumatically, the minimum test pressure shall be 110 percent of the design pressure.

C. Static Head Test

This test covers leak testing of all non-pressure plumbing and drainage systems, including sanitary sewer, storm drainage, etc. All piping in this test shall be subjected to an internal test pressure not less than 10-foot static head of water.

3.03 PRESSURE TESTING: PREPARATION FOR FIELD PRESSURE TEST

- A. All valves (except vents, drains, and hydro boundary valves) within the system to be tested shall be in open position; control valves shall be specifically checked to assure that they are in an open position or they shall be bypassed or removed during testing.
- B. Shut-off valves at instruments on process lines or equipment shall be closed.
- C. Equipment that is not to be hydrostatically tested shall be isolated or removed from the system. If valves are used for isolation, Contractor shall verify that valves can withstand the test pressure in the closed position without any damaging effect.
- D. System relief and safety valves shall be blanked off at the inlet flange of the valves. Screwed relief and safety valves shall be removed and replaced with plugs, or capped.
- E. All flanges, threaded joints and welds shall be left bare of insulation and unpainted. All underground pipe joints shall be bare and exposed for a distance of two feet on each side of joints and shall not be backfilled or encased in concrete until final testing approval.
- F. All joints, including welds, shall be left uninsulated and exposed for examination during the test; however, joints previously tested in accordance with this specification may be insulated or covered. If a sensitive test is required, all joints mentioned above shall be left unprimed and unpainted.
- G. Underground portions of piping systems may be tested and covered before testing aboveground portions.
- H. Piping designed for vapor or gas shall be provided with additional temporary supports, if necessary to support the weight of the test fluid. Where required, temporary supports shall be specified in the pressure test documents.
- I. Before testing:

Piping systems shall have been completely checked (Punched Out).

All lines, vessels, and equipment shall be checked to ensure that the entire system can be completely drained after testing.

Vents or other high point connections shall be opened to eliminate air from lines that receive a hydrostatic test.

System shall be purged of air before hydrostatic test pressure is applied.

System shall be thoroughly vented to remove all air pockets before the hydrostatic test pressure is applied.

Field personnel shall review all vessels and internals in order to determine best method to prevent air entrapment when filling and to prevent vacuum when draining.

Short pieces of piping that must be removed to permit installation of a blind or blank shall be tested separately.

Lines containing check valves shall have the source of pressure located in the piping upstream of the check valve so that the pressure is applied under the seat. If this is not possible, remove or jack up the check valve closure mechanism or remove check valve completely, and provide necessary filler piece or blinds.

When conducting tests at freezing temperatures, the test shall not take more than 4 hours, and special precautions (such as warming the line test water, or both) shall be observed to avoid freezing damage.

Systems that include expansion joints shall be investigated to see that any required temporary restraints, anchors, or guides are installed before test.

When a pressure test is required to be maintained for a period of time during which the testing medium in the system would be subject to thermal expansion, provision shall be made for relief of any pressure greater than the maximum test pressure.

3.04 FIELD PRESSURE TEST PROCEDURES

A. General:

Pressure Testing and Cleaning Procedure Index:

Pressure testing procedures shall be selected based on service and line class according to the table as included herein under the heading PIPING SYSTEMS: CLEANING AND TESTING.

The testing of piping and/or tubing, and equipment shall be performed on a system basis, in preference to the testing of individual lines or single components if at all possible. Breaking joints to insert blinds for hydrostatic testing shall be avoided wherever possible.

Special equipment shall be tested only as per instructions by the Engineer and/or Owner.

B. Hydrostatic Pressure Test:

In order to hydrostatic test as much piping as possible at one time, a systems test may be employed. This test shall include 1 or more lines and if possible connected vessels and equipment.

The minimum test pressure for a system test shall be such that each line in the system is subjected to a test pressure in accordance with the table as included herein under the heading PIPING SYSTEMS: CLEANING AND TESTING.

The maximum system test pressure shall not exceed the pressure test rating of any piping component or the shop test pressure of any vessels or equipment included in the test system. (Maximum test pressure for flanges and valves conforming to ASME B16.5 are given in the table

as included herein under the heading PIPING SYSTEMS: CLEANING AND TESTING.

Systems or sections of systems to be tested may be isolated by closed valves, provided the valve body and seat are suitable for the test pressure. Do not use closed diaphragm valves for isolation.

Where a suitable valve is not available, vessels, equipment, or other piping not included in the system pressure test shall be either disconnected from the a system or isolated by blinds or other means during the test.

The normal locations for the pressure test gauge are at grade near the pressure test pump. Readings may be made at higher points providing the gauge pressure reading and the static head (0.433 psi/ft) between grade and the point of measurement do not exceed the maximum

test pressure. Pressure test gauges shall be calibrated once a month, using a dead weight tester. Gauges shall be tagged with the date last calibrated, and this activity shall be recorded.

Hydrostatic test pressure shall not be applied until the vessel or equipment and its contents are at approximately the same temperature. To minimize the risk of brittle fracture, pressure tests through vessels and equipment shall not be conducted when the test liquid or metal temperature is below 60°F.

Hydrostatic test pressure shall be maintained for a sufficient length of time to visually determine whether there are any leaks, but not less than 1 hour. Contractor shall not be required to maintain test pressure in excess of 2 hours after notification of the client's authorized inspector.

C. Pneumatic Test Procedure:

Minimum Metal Temperature

At time of testing the minimum pipe metal temperature shall be as follows:

All ferric piping: 60°F
All copper: 40°F

Minimum temperatures for materials not listed above, shall be determined by the Engineer of Record and the Owner when required by field construction.

Clear the test area of all nonessential personnel before bringing the line up to test pressure. It may be desirable to conduct pneumatic tests during weekends when fewer personnel are deemed necessary to protect workers during such tests.

A pressure relief device shall be provided, having a set pressure not higher than the test pressure plus the lesser of 50 psi or 10 percent of the test pressure.

When pneumatic testing at over 25 psig, a preliminary check at 25 psig shall be made to locate major leaks. The pressure shall be increased in gradual steps of 5 psig, or 10 percent of the test pressure, whichever is greater.

A double block and bleed valve arrangement shall be included in the pressurizing line to the system being tested. A test pressure gauge shall be downstream of the double block. After each pressure step has been reached, close the block valve and open the bleeder to atmosphere. If after a 5-minute period the step pressure is held, proceed to the next step pressure. If not, examine the entire system for leakage.

Before soaping the joints, the entire line should be walked to determine whether there is any audible evidence of leakage. Any leaks found at the time shall be marked, and repaired after first

de-pressuring the line.

When the system has been brought up to the test pressure shown on the line list, all joints and welds shall be covered with soap solution in order to detect any leakage.

Soap solutions are to be low chloride and designed specifically for use in pneumatic testing of stainless steel systems.

Bolting shall not be tightened while systems being tested are pressured above 30 psig.

Pneumatic test pressure shall be maintained for a sufficient length of time to permit thorough visual inspection of all joints and weld seams but not less than 2 hour. Pressure shall be reduced gradually when de-pressuring.

D. Static Head Test Procedure

Underground pipe joints shall be exposed for a distance of two feet on each side of joints and shall not be backfilled until piping has been tested and approved.

Piping which connects to or is continuous with lines installed by others shall be isolated from these lines by a valve or line blind.

All openings will be provided with temporary plugs except the highest (fill opening)

Piping system shall be filled with clean water to the top vent stack. Systems without a vent stack shall be provided a temporary vertical stack. Stack shall be at least 10 feet in length.

Water shall stand in the system without change in level for a time period of not less than 5 hours.

Joints having leaks shall be repaired and retested for a time period of 1 hour.

E. Test Completion

In the event that repairs or additions are made following the pressure test, the affected piping shall be retested at the pressures originally specified for the test

After completion of testing, all temporary blanks and blinds shall be removed, all operating blinds returned to proper position, and all lines and piping components shall be completely drained. Valves, orifice plates, expansion joints, and short pieces of piping that have been removed shall be reinstalled with as specified proper new gaskets in place. All valves that were closed during hydrotest shall be opened to ensure drainage of the bonnet cavity. Lines being drained after testing shall have all vents open. Piping systems downstream of check valves should be inspected to ensure complete drainage.

Direct connected transmitters at orifice flanges must be disconnected when replacing orifice plates to avoid distorting the connections.

Care shall be exercised in controlling the rate of drainage from vessels with respect to the inflow of air through the vent to ensure that the vessel is not subjected to vacuum. After vessels have been completely drained, vents, cyclones, and other internal closures that were opened before testing shall be closed.

After lines have been drained, temporary supports shall be removed, and insulation and painting completed. Spring hangers provided with stops to carry the test load shall have these stops removed in accordance with Field Instruction provided on Form E-326, Constant Support Spring Hanger, and Form E-327, Variable Support Spring Hangers for each hanger.

3.05 CLEANING; GENERAL PREPARATION

- A. General Contractor shall schedule testing so that sanitizing and passivation of tubing system(s) immediately follows testing of system.
- B. Schedule field cleaning as close to the commissioning of the equipment as possible.
- C. Protect threaded connections, flange faces, and valves to prevent damage by abrasion.
- D. Block off, disconnect or remove the following items from the piping system to be cleaned:

Materials that may become damaged by cleaning solutions or procedures

- E. Do not allow aluminum, copper, galvanized steel, magnesium, or zinc surfaces to come in contact with solutions having a pH of less than 4.0 or a pH more than 10.
- F. Do not contact equipment containing austenitic material with the following materials:

Acid solutions containing halides or chemicals such as hydrochloric acid. Alternative solvents are acceptable provided the chloride content does not exceed 50 ppm (50 cubic centimeters/cubic meters).

Caustic soda (NaOH) solutions. If degreasing is required, Sodium Carbonate and Trisodium Phosphate solutions may be used, provided the chloride content does not exceed 50 ppm (50 cubic centimeters/cubic meters).

- G. Do not introduce chemical solution into equipment unless high point vents and low point drains (supplied by piping contractor) are available to ensure proper filling and complete removal of solutions.
- H. Do not apply heat directly to equipment containing acid solutions. Boilers may be fired for degreasing, but acid solutions must be diluted and heated externally to the equipment.

END OF SECTION 23 04 40

**SECTION 23 10 00
PLUMBING**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 01 and the following listed sections as a minimum, apply fully to work in this section.

Section 23 00 00 MECHANICAL GENERAL REQUIREMENTS

- B. Refer to and coordinate all work with the work of the following listed Sections:

Section 23 00 50 MECHANICAL: ELECTRICAL COMPONENTS

Section 23 01 50 MECHANICAL: VIBRATION ISOLATION

Section 23 02 50 MECHANICAL: PIPE HANGERS AND SUPPORTS

Section 23 03 00 MECHANICAL: FIRE SAFING / FIRESTOPPING

Section 23 04 00 MECHANICAL: INSULATION

Section 23 04 40 MECHANICAL: PIPE CLEANING TESTING

Section 23 15 00 PLUMBING: FIXTURES

1.02 SCOPE:

- A. Provide labor, equipment and materials to complete the work indicated on drawings and herein specified.
- B. Work specified within this Section is limited to 5'-0" beyond building limit.
- C. Work required beyond 5 ft from building limit is specified within Division 31.

1.03 RELATED WORK:

- A. Work in conjunction with this section shall be as designated below:

General Contractor:

Cutting, Patching, and Painting
Openings in roofs / Flashing
Openings in walls
Equipment foundations and bases
All temporary heating

Electrical Contractor:

Power wiring for electrical equipment provided within this section.

1.04 PROJECT ADMINISTRATION:

- A. Transmit questions, submissions, notices, and correspondence through the general contractor for transmittal to the Architect.
- B. Prepare and transmit to the Architect all submittal requirements within the time period allowed. See Schedule of Submissions.

1.05 SUBMITTALS:

- A. See SUBMITTAL GENERAL REQUIREMENTS within Section 23 00 00.
- B. The following shop drawings shall be prepared and submitted for approval within the time period stated (see SCHEDULE OF SUBMISSIONS in Section 23 00 00): (The list is not intended to be all inclusive. Provide submittals for all materials and equipment proposed for use on this project.)

Pipe and fittings
Hangers / Supports
Valves
Insulation
Clean outs
Floor drains
Roof Drains
Backflow preventers
Fixtures and Fixture carriers (See Section 23 15 00)
Hot Water Heaters
Potable Water Expansion Tanks
Vacuum breakers
Wall Hydrants
Roof Hydrants

1.06 INSPECTION AND TESTING: BY AUTHORITIES / AGENCIES

- A. Inspections, examinations and tests required by authorities/agencies shall be coordinated and paid for as necessary by the Plumbing Contractor to obtain complete and final acceptance of the systems. Transmit certificates of inspection, acceptance to the Architect.

1.07 QUALITY ASSURANCE:

- A. All cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute (CISPI) and be listed by NSF International.

1.08 FLUSHING, CLEANING AND TESTING: BY CONTRACTOR

- A. Provide all labor, equipment and expertise to flush, clean and test all piping systems installed. Isolate all sections and equipment as necessary to complete the flushing, cleaning and testing according to the requirements of SECTION 23 04 40 MECHANICAL: PIPE CLEANING - TESTING.

1.09 UTILITY CONNECTIONS / COORDINATION / METERS

- A. Review all contract documents with the proper utility companies prior to the start of any work to insure that meters, testing, inspections, acceptances will all be properly completed in a timely manner.
- B. Report any alterations required to insure utility company coordination.

1.10 ENERGY CONSERVATION:

- A. All work shall be in compliance with the energy conservation requirements of the IECC.
- B. Work indicated in excess of the minimum shall be provided as shown.
- C. Provide proper insulation, heat traps, controls and equipment such that systems are energy conserving and efficient.

1.11 PROJECT CLOSEOUT:

- A. Review and provide closeout requirements of this section and Section 23 00 00 Mechanical General Requirements, including:

- Testing and Adjusting
- Operating, Maintenance Instructions
- Lubrication
- Cleaning
- Sterilization
- Record Drawings
- Written Guarantee
- Operating, Maintenance Manuals
- Test Log
- Letters of compliance

PART 2 - PIPING: PRODUCTS AND INSTALLATION

2.01 PIPING: INSTALLATION, GENERAL:

- A. Provide new, standard products, materials and equipment which comply with the specification; are undamaged and unused at the time of installation; are complete with accessories, trim, finish, safety guards and other devices and details needed for a complete installation and for the intended use.
- B. Arrange and install piping approximately as indicated, straight, plumb, and as direct as possible. Form right angles or parallel lines with building wall. Keep pipe close to walls, partitions and ceilings. Offset only where necessary to follow walls. Where so indicated and wherever possible, conceal piping in building construction before erection of closing construction. When furred spaces are indicated, keep pipes as close to structural members as possible. Piping shall not interfere with openings, doors and windows. Allow for proper clearance at windows, doors, equipment and other building parts such that pipes do not interfere with access and building use.

- C. Piping shall be cut accurately to measurements established at the site and shall be installed without springing, forcing and excessive cutting or weakening of building structure. Pipes shall be installed in a manner permitting proper drainage, venting and free expansion and contraction. Changes in direction shall be made with factory-manufactured fittings.
- D. Install pipe to allow for expansion without excessive stress on pipe, hangers and building.
- E. Welding, brazing, soldering shall be with proper regard for fire prevention and safety. See Fire Watch requirements.
- F. Arrange piping passing through floors, walls and other partitions of building construction so that piping is centered in openings/sleeves and is rigidly supported on both sides of openings/sleeves.
- G. Clean pipe, pipe fittings, and valves before erection. Cap or plug open ends of piping and equipment during construction to keep dirt and foreign material out of system.
- H. As specified elsewhere, certain service piping and associated fittings. Valves and accessories will be furnished factory-cleaned and sealed.
- I. Unions or flanges shall be used to facilitate piping installation, and shall be installed between shut-off valves and equipment to facilitate removal of equipment for repair.
- J. Provide dielectric unions where pipes of dissimilar metals are joined together.
- K. Isolate and drain existing systems as required to complete the Work. Fill, circulate and vent both new and existing systems as required for proper operation.
- L. Copper tube, of annealed or bending temper quality, where indicated to be installed without joints or fittings, shall be bent to accomplish changes of direction. Bending shall not collapse outside nor buckle inside of bend. Proper radius, method and tools required shall comply with Copper Tube Handbook.
- M. Do not route pipelines over switchboards, panels, motor control centers, individual motor starters and other electrical equipment.
- N. Avoid routing pipelines over electrical raceways and bus ducts. If these locations cannot be avoided, provide drip pans under pipelines. Also provide drip pans where indicated on the Drawings. Drip pans shall be constructed of minimum 22 gauge stainless sheet metal with waterproof mastic applied to interior seams and joints. Pan width shall be minimum 2 times pipe diameter and with sides turned up minimum of 4" high and fitted with hemmed edge. Do not hang drip pans from pipe. Pitch pans minimum 1/8" per foot and provide 3/4" drain connection at low points. Pipe drains to nearest floor drain or as shown on the Drawings.

2.02 CROSS AND INTER-CONNECTIONS:

- A. No piping for fixtures, equipment, devices or internal connections shall be installed which will provide a cross or interconnection, under any circumstance of operation, between a distributing supply for drinking or domestic purposes and a not-potable supply. A non potable supply would include a drainage system or a soil or sanitary waste pipe which would permit or make possible the backflow of sewage, polluted water or waste into the domestic water supply system.

2.03 PIPE: SANITARY SEWER PVC (Beyond Foundation)

PIPE CLASS:	P2
PIPE SYMBOL	SAN
CLEANING CLASS	C1
TESTING CLASS	T4

- A. Materials: Provide PVC Gravity Sewer Pipe with ring-tite joints complying with ASTM D 3034-SDR35.
- B. Appurtenances: Provide elbows, tees, wyes, couplings, caps of the same type and class of material as the pipe, or of a material having equal or superior physical and chemical properties.
- C. Installation:
 - Install pipe in accordance with governing authorities having jurisdiction.
 - Inspect pipe prior to installation to detect any apparent defects. Mark defective material with white paint and remove from site.
 - Lay pipe beginning at the low point of the system, true to the grades, inverts and alignment indicated with unbroken continuity of invert.
 - Install compression gaskets in accordance with manufacturer's instructions as to lubricants, cements, and other special requirements.
- D. Installer: A firm specializing and experienced in sanitary sewer system work for not less than two (2) years.
- E. Connections: Provide connection to manholes as indicated and in accordance with the sewer authority. Provide labor and materials to rework table as required.
- F. Changes in direction/elevation: Roll down or offset at no greater than 45 deg.
- G. Cleanouts: Provide cleanouts to grade at all changes of direction / elevation, at intervals as required by Code and as indicated on the drawings.
- H. Building Sewer Cleanout: Provide at the point sanitary piping exits the building a cleanout to floor level with specified cover/cap.
- I. Bedding: Provide sand/gravel bedding material. No stone, ledge to be within 6" of invert of pipe. Provide pipe cradles in fill or unsuitable material.
- J. Cover: Provide minimum of 3'-0" cover. Notify Architect if this requirement does not appear to be attainable.
- K. Test: Cap or plug piping at any manhole and fill system to grade, let stand for a period of 2 hours, no appreciable fall in level will be allowed.

2.04 PIPING: SANITARY WASTE and VENT, PVC (BELOW SLAB)

PIPE CLASS: P1
PIPE SYMBOL SAN
CLEANING CLASS C1
TESTING CLASS T4

- A. Material: Provide type PVC Schedule 40 sanitary drainage piping with drainage type fittings, free of defects, as manufactured by Celanese, Yardley or ITT Grinnell.
- B. Joints: Solvent fused socket type with chemical designed for use with the type PVC piping system.
- C. Cleanouts: Provide cleanouts at changes of direction and at intervals as required by Code and as indicated.
- D. Workmanship: Pitch piping at a rate of 1/4 " per foot unless noted otherwise and install parallel or perpendicular to building. Allow for continuous bearing of pipe on soil.
- E. Connections: Provide wye branches with 45 deg elbows at connections. Use long sweep bends at bottom of all stacks.
- F. Changes in direction/elevation: Roll down or offset at no greater than 45 deg.
- G. Cleanouts: Provide cleanouts to grade at all changes of direction / elevation, at intervals as required by Code, and as indicated on the drawings.
- H. Building Sewer Cleanout: Provide at the point sanitary piping exits the building a cleanout to floor level with specified cover/cap.
- I. Inspection/Testing: Provide labor and equipment to test the underground piping system as follows:
 - 10 feet water head applied to piping for a period of 2 hours.
- J. Inspect all joints to insure watertight connections, coordinate approval of local authority prior to backfill.

2.05 PIPING: SANITARY WASTE and VENT - PVC (ABOVE SLAB)

PIPE CLASS: P1
PIPE SYMBOL SAN – For VENT see legend
CLEANING CLASS C1
TESTING CLASS T4

- A. Material: Provide type PVC Schedule 40 sanitary drainage piping with drainage type fittings, free of defects, as manufactured by Celanese, Yardley or ITT Grinnell.
- B. Joints: Solvent fused socket type with chemical designed for use with the type PVC piping system.
- C. Cleanouts: Provide cleanouts at changes of direction and at intervals as required by Code and as indicated.
- D. Workmanship: Pitch piping at a rate of 1/4 " per foot unless noted otherwise and install parallel or perpendicular to building.

- E. Supports: See PIPE SUPPORTS.
- F. Vents through roof: Provide no-hub cast iron vents through roof. Provide rigid support to structure at and below roof to insure stable vertical vent.
- G. Fixture Waste Connections: Exposed piping to plumbing fixtures shall be chrome plated brass with chrome plated brass traps as specified. Fixtures shall be trapped separately with trap screws below water line.
- H. Inspection/Testing: Provide labor and equipment to test the piping system as follows:
 - Fill system to roof for a period of 2 hours.
- I. Inspect all joints to insure watertight connections, coordinate approval of local authority prior to closing in.

2.06 PIPING: DOMESTIC WATER, ABOVE GRADE:

PIPE CLASS: U2
PIPE SYMBOL CW / HW / HWR See Legend
CLEANING CLASS C3
TESTING CLASS T2

- A. Material: Pipe shall be Type-L copper tubing with wrought copper fittings as manufactured by Revere, Anaconda, or Chase.
- B. Joints: Install with sweat joints with lead free solder; remove all excess flux and solder from piping.
- C. Water Hammer Arrestors: At all branches and risers, provide water hammer arrestor as specified under Part 5 -Equipment/Appurtenances.
- D. Workmanship: Ream pipe to full inside diameter to remove all burrs before joining. Install piping parallel or perpendicular to building or as indicated. Install in a manner to allow for expansion.
- E. Test: Perform a hydrostatic pressure test at 150 psi for a period of 30 minutes until system is proved tight. Test pressure drop shall not exceed 1 psi during test period. For piping that is to be concealed, perform all tests while accessible.

2.07 COPPER PRESS TYPE FITTINGS: (Contractor's Option)

- A. Manufacturers, Copper Press Fittings:

Viega, 17545 Daleview Dr., Lakewood, OH 44107, 877.620.0016 or Ridge Tool Co., 400 Clark Street, Elyria, OH 44035, 800.519.3456

- B. Material:

Press Fittings: Copper press fittings shall conform to the material and sizing requirements of ASME B16.18 or ASME B16.22. O-rings for copper press fittings shall be EPDM.

C. Installation, Fittings for Copper Tubing:

Press connections: Copper press fittings shall be made in accordance with the manufacturers installation instructions. The tubing shall be fully inserted into the fitting and the tubing marked at the shoulder of the fitting. The fitting alignment shall be checked against the mark on the tubing to assure the tubing is fully engaged (inserted) in the fitting. The joints shall be pressed using the tool approved by the manufacturer.

2.08 PIPE STERILIZATION, DOMESTIC WATER PIPING SYSTEMS:

A. Pipe Sterilization: Sterilize the system with chlorine prior to acceptance for domestic use in accordance with requirements of AWWA C651, AWWA C652, or as described as follows:

The piping system shall be flushed with clean, potable water until dirty water does not appear at the points of outlet.

Once clean water has been found to be flowing at all points of outlet, the system, or part thereof, shall be filled with a water/ chlorine solution containing at least 50 parts per million (50mg/L) of chlorine, and the system, or part thereof, shall be valved off and allowed to stand for 24 hours. As an alternate, the system, or part thereof, shall be filled with a water/chlorine solution containing at least 200 parts per million (200 mg/L) of chlorine and allowed to stand for 3 hours.

Following the required standing time, the system shall be flushed with clean potable water until the chlorine is purged from the system.

The procedure shall be repeated where shown by a bacteriological examination that contamination remains present in the system.

2.09 PIPING: DOMESTIC WATER, PEX TUBING

PIPE CLASS:	H1
PIPE SYMBOL	CW / HW / HWR See Legend
CLEANING CLASS	C3
TESTING CLASS	T2

A. General:

Domestic potable hot and cold water plumbing system, where shown on the Drawings and Schedules, shall be crosslinked polyethylene pipe, and shall include the following:

Crosslinked polyethylene (PEXa) piping.
Distribution manifold(s) with balancing and flow control valves where required.
Cold-expansion and compression-sleeve fittings.
Pipe fasteners as approved by the manufacturer of the PEXa piping.
Supervision and field engineering required for the complete and proper function of the system.

B. Scope:

Domestic hot and cold water piping, concealed from view, within dwelling units.

C. References:

Publications listed here are part of this specification to the extent they are referenced. Where no specific edition of the standard or publication is identified, the current edition shall apply.

ASTM - American Society for Testing and Materials

ASTM D2765 – Standard Test Method for Determination of Gel Content and Swell Ratio of

Crosslinked Ethylene Plastics

ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials

ASTM E119 – Standard Test Methods for Fire Tests of Building Construction and Materials

ASTM F876 – Standard Specification for Crosslinked Polyethylene (PEX) Tubing

ASTM F877 – Standard Specification for Crosslinked Polyethylene (PEX) Plastic Hot- and

Cold-Water Distribution Systems

ASTM F2023 – Standard Test Method for Evaluating the Oxidative Resistance of Crosslinked

Polyethylene (PEX) Tubing and Systems to Hot Chlorinated Water

ASTM F2080 – Standard Specification for Cold-Expansion Fittings with Metal Compression- Sleeves for Crosslinked Polyethylene (PEX) Pipe

AWWA – American Water Works Association

AWWA C904-06 - Crosslinked Polyethylene (PEX) Pressure Pipe, 1/2 In.(12 mm) Through 3

In. (76 mm), for Water Service

CSA Canadian Standards Associations

CSA B137.5 – Crosslinked Polyethylene (PEX) Tubing Systems for Pressure Applications

IAPMO – International Association of Plumbing and Mechanical Officials

ICC – International Code Council

ISO – International Organization for Standardization

ISO 9001 – Quality Management Systems – Requirements

NSF International

NSF/ANSI 14 – Plastic Piping System Components and Related Materials

NSF/ANSI 61 – Drinking Water System Components – Health Effects

Plastic Pipe Institute

PPI TR-3 / 2007 – Policies and Procedures for Developing Hydrostatic Design Basis (HDB), Pressure Design Basis (PDB), Strength Design Basis (SDB), and Minimum Required Strength (MRS) Ratings for Thermoplastic Piping Materials or Pipe

Underwriters' Laboratories

ANSI/UL 263 – Standard Fire Tests of Building Construction and Materials

Underwriters' Laboratories of Canada

CAN/ULC S101 – PEX Pipe through Fire Rated Assemblies

CAN/ULC S102.2 – Surface Burning Characteristics of Flooring, Floor Covering and Miscellaneous Materials

D. Definitions:

Crosslinked polyethylene, commonly abbreviated PEX, is made from high density polyethylene (HDPE). Crosslinking is accomplished during manufacturing. Crosslinking enhances the physical & mechanical properties of the polymer. The high-temperature properties are improved. Chemical resistance is enhanced by resisting dissolution. Low temperature properties are also improved; its impact and tensile strength, scratch resistance, and resistance to brittle fracture are enhanced. The required degree of crosslinking, according to ASTM Standard F876-07, is between 70-89%. This specification requires PEX to be designated as PEXa and be manufactured by the high-pressure peroxide method.

E. Design Requirements:

Standard grade hydrostatic pressure ratings from Plastics Pipe Institute in accordance with TR-3. The following three standard-grade hydrostatic ratings are required:

200°F (93°C) at 80 psi (551 kPa)
180°F (82°C) at 100 psi (689 kPa)
73.4°F (23°C) at 160 psi (1102 kPa)

Certification of flame spread/smoke development rating of 25/50 in accordance with ASTM E84 and ULC S101 for the following PEX pipe sizes. It may be necessary to encase with 1/2 inch fiberglass insulation at tube spacing of not less than 4 inches apart, as required by the specific manufacturer. Certain sizes may not conform to this standard; appropriate insulation shall be installed to meet the standard.

3/8 inch (9.53 mm) b. 1/2 inch (12.7 mm) c. 3/4 inch (19.05 mm) d. 1 inch (25.4 mm)
1 1/4 inch (31.75 mm) f. 1 1/2 inch (38.1 mm) g. 2 inch (50.8 mm)

F. Performance Requirements:

To provide a domestic potable hot and cold water plumbing system, which is manufactured, fabricated and installed to comply with regulatory agencies and to maintain performance criteria stated by the PEX pipe manufacturer without defects, damage or failure.

Material shall be Compliant to the following standards:

NSF/ANSI Standard 14
NSF/ANSI Standard 61

ASTM F877
ASTM E119

ANSI/UL 263 through certification listings with Underwriters Laboratories, Inc. (UL).

UL Design No. L557 — 1 hour wood frame floor/ceiling assemblies
UL Design No. K913 — 2 hour concrete floor/ceiling assemblies
UL Design No. U372 — 1 hour wood stud/gypsum wallboard wall assemblies
UL Design No. V444 — 1 hour steel stud/gypsum wallboard wall assemblies

G. Submittals:

Comply with Division 1 Submittal Procedures. Approval and/or acceptance of all submittals are required prior to fabrication.

Submit manufacturer's Technical Manual, submittal forms, catalog cuts, brochures, specifications, and installation instructions. Submit data in sufficient detail to indicate compliance with the contract documents.

Submit manufacturer's instructions for installation.

Submit data for equipment, fittings, fasteners and associated items necessary for the installation of the piping and manifolds.

Submit computer-generated system design indicating pipe sizing, flow rates and temperatures.

Shop Drawings: Provide plans drawn to scale for all installation areas. Indicate dimensions, descriptions of materials, general construction, component connections, and installation procedures. Indicate design, schematic layout of system, including equipment and critical dimensions as well as details for protecting exposed PEX piping.

H. Certification:

Submit independent certification results for the piping systems from an accredited independent testing laboratory.

The design shall be approved by a professional appropriately licensed in the jurisdiction where the installation will take place, as being complete and accurate.

Fittings shall be third-party as approved by the manufacturer's PEX piping system with applicable plumbing and mechanical code certifications.

Fittings encased behind walls or ceilings shall be certified to ASTM F2080.

I. Samples:

Submit samples of metal and exposed finishes if requested by Architect.

Maintenance Instructions:

Submit instructions for any maintenance required or recommended by manufacturer.

J. Quality Assurance

Manufacturer: Must be a company specializing in the Work of this Section with a minimum of 5 years documented experience. All components shall be supplied by one manufacturer.

Pipe shall be manufactured in a facility whose quality management system is ISO 9001 certified.

Crosslinked polyethylene (PEXa) pipe shall conform and be certified to ASTM F876, F877 and CSA B137.5. Fittings shall conform and be certified to ASTM F877 or F2080, and CSA B137.5.

K. Delivery, Storage, And Handling:

Deliver and store piping and equipment in shipping containers with labeling in place.

Pipe shall be kept in original shipping boxes until required for installation.

Store piping and equipment in a safe place, dry, enclosed, under cover, in a well-ventilated area. Do not expose pipe to ultraviolet light beyond exposure limits recommended by manufacturer. Protect piping and manifolds from entry of contaminating materials. Install suitable plugs in open pipe ends until installation.

Where possible, connect pipes to assembled manifolds to eliminate possibility of contaminants and cross-connections.

Piping shall not be dragged across the ground or other surfaces, and shall be stored on a flat surface with no sharp edges.

Protect materials from damage by other trades.

Pipe shall be protected from oil, grease, paint, direct sunlight and other elements as recommended by manufacturer.

L. Warranty:

Provide manufacturer's standard written warranty.

The warranty shall include as a minimum, provisions to repair defects from faulty materials or workmanship developed during the guarantee period, or provide for replacement with new materials, at no expense to Owner.

The pipe manufacturer shall warrant the cross linked polyethylene piping to be free from defects in material and workmanship for a period of twenty-five (25) years starting at completion of successful pressurized water tests immediately following system installation.

Cold-expansion compression-sleeve pipe repair couplings shall be warranted to be free from defects in material and workmanship for a period of twenty-five (25) years starting at completion of successful pressurized water tests immediately following system installation.

All manifolds and distribution headers shall be warranted to be free from defects in material and workmanship for a period of two (2) years starting at completion of successful pressurized water tests immediately following system installation.

Provide installer's guarantee as specified within Section 23 00 00.

M. Acceptable Manufacturer:

REHAU, 1501 Edwards Ferry Road, NE; Leesburg, VA 20176; email:
rehau.mailbox@rehau.com; IPEX, Wirsbo, Zurn or Nibco.

N. Piping:

All pipe shall be high-density crosslinked polyethylene manufactured using the high-pressure peroxide method of crosslinking (PEXa). Pipe shall conform to ASTM F876, ASTM F877 CSA B137.5, NSF/ANSI 14 and NSF/ANSI 61.

Pipe shall be rated for continuous operation of 100 psi gauge pressure at 180°F temperature (690 kPa @ 82°C), and 80 psi gauge pressure at 200°F temperature (550 kPa @ 93°C).

Pipe shall be certified by PPI to standard TR-3, with applicable plumbing and mechanical code certifications.

Pipe to be manufactured using a high-pressure peroxide method with a minimum degree of crosslinking of 70-89% when tested in accordance with ASTM D2765, Method B.

Pipe to be tested for resistance to hot chlorinated water in accordance with ASTM F2023.

Pipe to have a minimum extrapolated time-to-failure of 50 years, calculated in accordance with section 13.3 of F2023 and listed as “3006” per the ASTM F876 standard.

When required, PEX pipe to have a co-extruded colored UV Shield made from UV-Resistant polyethylene providing UV resistance.

Bend Radius: The minimum bend radius for cold bending of the pipe shall be not less than five (5) times the outside diameter.

Bends with a radius less than this shall require the use of a bending template as supplied by the pipe manufacturer, and/or hot air.

Pipe to have a Flame Spread Index of less than 25, and a Smoke Developed Index of less than 50 when tested in accordance with ASTM E84 (in U.S.) or CAN/ULC S102.2 (in Canada). In any case where the pipe does not conform to these standards, appropriate piping insulation shall be installed in order to meet the standard.

O. Fittings:

All Fittings used with cross-linked polyethylene (PEX) water distribution pipe intended for plumbing applications shall be of the cold-expansion compression-sleeve design.

All Fittings shall be third-party certified to applicable standards ASTM F877, ASTM F2080, NSF/ANSI 14, NSF/ANSI 61 and CSA B137.5 and approved by the manufacturer’s PEX piping system, with applicable plumbing and mechanical code certifications.

Compression-sleeve fittings shall be manufactured of brass and shall be supplied by the piping manufacturer as part of a proven cataloged system.

Where fittings are encased in concrete or buried underground, fittings shall be wrapped as per manufacturer’s recommendation to protect the material.

P. Manifolds:

Material: Distribution manifolds shall be manufactured of copper and be supplied by the piping manufacturer as a proven cataloged part of the manufacturer's system.

Copper manifolds: Copper manifolds shall be manufactured from Type L copper. Copper and/or brass outlets shall be high-temperature brazed (lead-free) into headers. Outlets in copper headers shall be made using the T-drill process according to ASTM F2014.

Q. Markings:

Pipe shall carry the following markings every three (3) feet (0.9 meters): Manufacturer's name or trademark, nominal size, PEXa 3006 (material designation) SDR9 (standard dimension ratio), ASTM F876/ F877 / F2080, CSA B137.5, NSF-pw, UPC Shield, 160 psi @ 73.4°F / 100 psi @ 180°F / 80 psi @ 200°F, POTABLE TUBING, manufacturing date and footage mark.

R. Packaging:

Coiled pipe shall be shipped in protective cardboard boxes marked with product name and size. Straight lengths shall be packed in plastic bags.

S. Acceptable Installers:

As a minimum, installation shall be performed by qualified laborers trained by the manufacturer in the procedures of PEX systems and they shall be appropriately licensed for the jurisdiction where the installation will take place.

T. Examination:

Examine areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of work. Do not proceed until unsatisfactory conditions are corrected.

U. Preparation:

Prepare a suitable cavity for the manifold, with a secure mounting plate that will secure the manifold at least 30 inches above floor level. Manifold must be installed in an area that will allow easy access for piping as well as future access for maintenance.

V. Installation:

Install in accordance with manufacturer's published installation manual and/or published guidelines and final shop drawings.

Manifolds shall be mounted as level as possible.

Route piping in an orderly manner, according to layout and spacing shown in final shop drawings.

At connections and fittings, use a plastic pipe cutter to ensure square (90°) and clean cuts, and join pipes immediately or cap ends of pipe to seal from contaminants.

Pipe shall be dispensed using a suitable uncoiling device. Remove twists prior to securing pipe.

Pipe shall lie flat on an even plane.

Piping that passes through expansion joints or walls shall be covered in protective polyethylene convoluted sleeving (flexible conduit) extending 15 inches (38 cm) on each side of the joint. Sleeving shall be secured on pipe to prevent movement during installation.

Where piping enters or exits a wall a protective conduit shall be placed around the pipe, with the conduit extending a minimum of 6 inches (15 cm) into the floor and exiting by a minimum of 6 inches (15 cm). For penetrations at manifolds, use rigid PVC bend guides secured in place to prevent movement.

W. Field Quality Control:

Filling, Testing & Balancing: Tests of domestic plumbing systems shall comply with authorities having jurisdiction, and, where required, shall be witnessed by the building official.

Pressure gauges used in testing and balancing shall show pressure increments of 1 psig and shall be located at or near the lowest points in the distribution system.

X. Air Test:

Charge the completed, yet unconcealed pipes with air at a minimum of 40 psig. Do not exceed 150 psig.

Use soap solution to check for leakage at manifold connections.

Y. Water Test:

Purge air from pipes.

Charge the completed, yet unconcealed pipes with water.

Take necessary precautions to prevent water from freezing.

Check the system for leakage, especially at all pipe joints.

Perform a preliminary pressure test pressurizing the system to the greater of 1.5 times the maximum operating pressure or 100 psig for 30 minutes.

As the piping expands, restore pressure, first at 10 minutes into the test and again at 20 minutes.

At the end of the 30-minute preliminary test, pressure shall not fall by more than 8 psig from the maximum, and there shall be no leakage.

After successfully performing the preliminary pressure test, perform the main pressure test immediately.

The test pressure shall be restored and continued as the main test for 2 hours.

The main test pressure shall not fall more than 3 psig after 2 hours.

No leakage shall be detected.

Complete inspection and furnish test reports supplied by the manufacturer of the system.

Z. Cleaning:

Clean exposed surfaces upon completion of installation using clean, damp cloth. No cleaning agents are allowed.

Comply with manufacturer's recommendations.

Protection:

Protect installation throughout construction process until date of final completion.

Replace components that cannot be repaired.

2.10 PIPING: SYSTEM TESTS

- A. Provide labor, instruments, and equipment necessary to complete all tests.
- B. Maintain a log of tests with dates, times, and type of test. Leaks found during testing periods shall be noted, identified, and corrected.

2.11 SUPPORTS: PIPE HANGERS:

- A. General: Provide pipe supports, hangers, or other appurtenance to firmly support the piping systems. All pipes shall be independently supported from the building structure and not from other pipes, flues, conduits, ducts or pipe hangers, etc.
- B. Refer to Section 23 02 50 – MECHANICAL PIPE HANGERS AND SUPPORTS for pipe hanging requirements.

2.12 VALVES: DOMESTIC WATER

- A. General: Provide valves where indicated and as required for proper isolation and operation of the domestic water distribution system. Provide shut off valves on all piping serving system risers, equipment, fixtures or banks of fixtures, and at wall hydrants.

Valves shall be designated for 125 psi working pressure unless noted otherwise.

Valves 2-1/2" and smaller shall be bronze or brass.

Valves 3" and larger shall be iron body brass mounted flange ends.

- B. Valves shall have the name or trademark of the manufacturer and the guaranteed working pressure cast on the body of the valve. Valves shall be as manufactured by Milwaukee, Stockham, Crane or Nibco. Valves for the project shall be the product of one manufacturer.

- C. Ball Valves, Class 150: 1/4" to 2" cast bronze 600# W.O.G., full port, screwed ends.

All valves to be installed within insulated pipeline shall be provided complete with valve stem extensions. Stem extensions shall be 2" minimum.

Milwaukee	BA-300
Apollo	77-14
Nibco	T-585-70

- D. Drain Valves: 1/4" to 2" cast bronze 600# W.O.G., full port, screwed ends w/ capped hose end, chain and cap.

Milwaukee	BA-1001T
Apollo	78-100

2.13 THERMOSTATIC BALANCING VALVES; DOMESTIC HOT WATER RECIRCULATING SYSTEM:

A. General:

Provide as indicated on the plans, thermostatic balancing valves for domestic hot water recirculating service. The thermostatic balancing valves shall be self contained and fully automatic without additional piping or control mechanisms. Valve shall be a Circuit Solver as manufactured by Therm-Omega-Tech, Inc., or equivalent.

B. Function:

The thermostatic balancing valves shall regulate the flow of recirculated domestic hot water based on water temperature entering Circuit Solver regardless of system operating pressure.

When fully closed thermostatic balancing valves shall bypass a minimum flow to maintain dynamic control of the recirculating loop and provide a means for system sanitizing.

Thermostatic balancing valves shall be factory adjustable from 105 F (40.5C) to 140F (60C) as required by project conditions. The balancing valves shall modulate between open and closed position within a 10F (5.5C) range.

C. Product:

The valves shall be available in sizes ranging from 1/2 inch NPT to 2" NPT. The valve body and all internal components shall be constructed of stainless steel with major components constructed of type 303 stainless steel.

Units sized from 1/2 inch through 2 inch shall be rated to 200 PSIG maximum working pressure. All balancing valves shall be standard tapered female pipe thread, NPT. All balancing valves shall be rated to 250F (121C) maximum working temperature and shall be ANSI/AWWA C800 compliant and NSF-61 compliant with zero lead content for use in all domestic water systems.

The valves' thermal actuator shall be spring operated and self cleaning, delivering closing thrust sufficient to keep orifice opening free of scale deposits and shall be rated for a minimum of 200,000 cycles.

Units shall be installed along with suitable line size isolation valves, unions, and strainer as indicated on the Drawings. Coordinate the required access panels as required in non-accessible ceilings and walls with the General Contractor.

2.14 TRAPS:

- A. Every plumbing fixture without a manufacturer's integral trap shall separately trapped by a water seal type trap. The vertical distance between the fixture outlet and the trap weir shall not exceed 14 inches. Plumbing fixtures shall not be double trapped.

- B. Each fixture trap shall have a liquid seal of not less than 2" and not more than 4". (Deeper trap seals may apply to special designs for accessible fixtures.)
- C. Where trap seals are subject to loss by evaporation, deep seal type traps shall be used.
- D. All floor drains shall be provided with deep seal type traps.

2.15 VALVES: SPECIAL TYPES

- A. Check Valves: 1/4" to 2" bronze 150#, threaded ends.

Milwaukee	510
Crane	137
Nibco	T-433-Y

- B. Balancing Valves: 1/2" to 2"

Provide balancing valves as indicated on the Drawings and at all return water connections to heating and cooling equipment. Balancing valves shall be Model CBV-S soldered or CBV-T threaded type Circuit Balancing Valves, as manufactured by Armstrong or approved equal.

Each valve shall have metering ports incorporating Nordel check valves, on both sides of the seat.

All valves shall be "Y" pattern equal percentage globe style, designed either for presetting with a balance schedule or for proportional balancing. All metal parts are bronze copper alloy. Each valve shall provide four functions:

- Precise flow measurement.
- Precision flow balancing.
- Positive shutoff with a no-drip soft seat.
- Diagnostic point for system analysis.

Valves shall have four full 360 degree adjustment turns of the handwheel with a micrometer-type indicator and hidden memory feature to program the valve for a precise, tamper-proof balanced setting. Metering ports shall be interchangeable with drain ports to allow for read-out flexibility when installed in tight piping locations.

2.16 SLEEVES, PLATES:

- A. Provide and locate sleeves, plates, anchors, and inserts required; mark openings before floors and walls are constructed or core bored.
- B. Provide sleeves for piping passing through floors, walls, roofs, partitions and masonry. Sleeves for concrete or masonry shall be Schedule 40 steel pipe of size to allow for pipe expansion and passage of vapor barrier insulation. Other sleeves shall be 20 gauge galvanized sheet steel with lockseam joint.
 - 1. Terminate sleeves flush with walls, partitions, and ceiling.
 - 2. Terminate sleeves 1/2" above finished floor where piping is exposed.
- C. Where ceiling inserts are provided specifically for the use of the Owner, install all work, so as to not interfere, with a separate support system.

2.17 FIRE SAFING: PIPING AND EQUIPMENT OPENINGS:

- A. Refer to Section 23 03 00 – MECHANICAL: FIRE SAFING, for requirements.

2.18 UNIONS:

- A. Provide union connections at equipment and as indicated. Unions 2" and smaller shall be wrought copper sweat type; larger shall be wrought copper flange type.

2.19 SANITARY SYSTEM CLEANOUTS:

- A. Provide cleanouts at all changes in direction, at intervals as required by Code, and as indicated.
- B. Floor cleanouts: Provide with dura-coated iron body, inside caulk outlet, cadmium plated iron plug, lead seal, adjustable nickel bronze top; Zurn or approved equal.

For concrete floor:	ZN-1400	Set flush with floor
For tile:	ZN-1400-T	Set parallel with and level with tile

- C. Wall Cleanout: Provide with cast iron supreme cleanout with cadmium plated plug, lead seal, and round stainless steel access cover with securing screw.

Model:	ZN-1445	With Z-1462 8x8 access
Model:	ZN-1446	With round wall access

PART 3 - INSULATION: PRODUCTS AND INSTALLATION

3.01 INSULATION: GENERAL:

- A. Provide all insulation as specified in a neat and workmanlike manner observing the best practices of the trade. All longitudinal seams shall be flat and facing away from view. Insulation shall be smooth throughout. Vapor barriers, where required, shall be continuous. No raw ends of material shall be permitted; cover same with eight ounce canvas or approved equal.
- B. Piping and equipment shall be insulated as specified within Section 23 04 00 – MECHANICAL INSULATION.

PART 4 – EQUIPMENT / APPURTENANCES

4.01 ACCESS PANELS:

- A. Provide coordination to properly locate panels that are provided within other sections of this Specification.

4.02 VACUUM BREAKERS:

- A. Provide approved vacuum breakers at all service sinks and wherever required by governing codes.

- B. Provide Watts #288 or approved equal vacuum breaker at hot water heater.

4.03 PRESSURE REDUCING VALVE:

- A. Provide pressure-reducing valve at building water service entrance if the supply pressure is in excess of 80 psig. Unit to be preset for 75psig.

Model: Watts U5 BG or approved equal.

4.04 FLOOR DRAINS:

- A. Refer to the SCHEDULE on the Drawings for floor drains to be provided. Provide floor drains as indicated as manufactured by Zurn, Josam or Smith. Zurn model numbers are used to set standards.
- B. All floor drains shall be fit with "Sure Seal" trap sealing devices as manufactured by Rectorseal. Trap sealing devices shall be ASSE 1072 and IPC approved.

4.05 WALL HYDRANT EXTERIOR:

- A. Provide as indicated wall hydrants with brass face, detachable T-handle, nozzle for 3/4" hose connection, integral vacuum breaker, length suitable for wall thickness, interior shut-off valve.

Model: Z-1310 Zurn or equal models by Smith or Josam.

4.06 ROOF HYDRANT EXTERIOR:

- A. Provide as indicated exposed, non-freeze roof hydrants, with Dura-Coated cast iron head and lift handle with lock option, bronze interior parts, galvanized steel casing, and bronze valve housing with 1/8 [3] IP drain port in housing.
- B. Unit shall be complete with Dura-Coated cast iron roof support sleeve with wide anchoring flange and clamp collar and interior shut off valve.
- C. Provide drain piping to discharge as indicated on the drawings.
- D. Unit shall be Model: Z-1388 Zurn or equal models by Smith or Josam.

4.07 BACKFLOW PREVENTER:

- A. General: Provide backflow preventers at all connections to the public water supply. Backflow preventers shall carry the approval of the UPC, The American Society of Sanitary Engineering, UL and FM.
- B. 2" and Smaller: Backflow prevention systems shall be comprised of all bronze construction. Housed within a single body shall be two check valves with removable seats, and a pressure relief valve with stainless steel seat. The backflow preventer assembly shall be isolated between two full ports, quarter turn, bronze body ball valves.

- C. Manufacturer's Data: Backflow preventers shall be Series 009, as manufactured by Watts. Equal products as manufactured by Hersey or Wilkins are acceptable.
- D. Provide drain piping to nearest floor drain.

4.08 CONNECTIONS TO KITCHEN EQUIPMENT:

- A. Provide labor and materials to install and/or connect to kitchen equipment furnished to the project under other sections of the specification. Refer to the drawings for the required scope of work.

4.09 CONNECTIONS TO LAUNDRY EQUIPMENT:

- A. Provide labor and materials to install and/or connect laundry equipment furnished to the project or for future installation.

Washer-Dryer Unit: Provide domestic water shut off isolation valve and waste standpipe.
Coordinate with Architect to suit equipment to be furnished.

4.10 WATER HAMMER ARRESTORS:

- A. Provide water hammer arrestors, in domestic water piping systems, properly sized, with adapters, and with nesting type bellows contained within a casing having sufficient displacement volume to dissipate the calculated kinetic energy generated in the piping system. Both casing and bellows constructed of Type 18-8 stainless steel.

Model: Z -1700 "Shoktrols" or equal models by J R Smith or Watts

- B. Provide complete submittal with models, sizes and locations for all arrestors.
- C. Locations: Provide arrestors at:
 - At all electric solenoid automatic valve locations
 - At all banks of three or more fixtures
- D. Coordinate the location of properly sized access panels with the arrestor location to assure proper access.

4.11 DOMESTIC WATER EXPANSION TANK

- A. Provide a potable, domestic water expansion tank on the supply line to the hot water heater. Unit shall be of steel construction, with rigid polypropylene reservoir liner, butyl diaphragm separating the air chamber from the domestic water, stainless steel lined inlet connector, FDA approved materials, field adjustable air pressure charge and with 3/4" male connection.
- B. Refer to the water heater details on the drawings for the model and capacity of potable water expansion tanks that will be required.

4.12 HOT WATER RECIRCULATING PUMP:

- A. Provide cartridge type circulator with cast bronze body, suitable for 175 psig working pressure and 300 degree F water temperature as manufactured by Taco or Bell & Gossett.

See RECIRCULATING PUMP SCHEDULE for size and capacities.

4.13 WATER HEATERS: HEAT TRAPS

- A. Provide heat traps at the inlet and outlet of all water heater tanks. Water heaters with integral factory installed heat traps shall be provided if available.

4.14 DOMESTIC WATER HEATING SYSTEM; INDIRECT TYPE, CONDENSING GAS FIRED:

- A. Provide a packaged type domestic water heating system of model and capacity as indicated in the SCHEDULE on the Drawings. Units shall be as manufactured by Lochinvar, Viessmann or Weil McLain.
- B. The domestic hot water supply shall be provided by a wall mount packaged water heating system. The package system shall consist of a wall mount water heater, a jacketed and insulated storage Tank, a stainless steel circulating pump, inlet and outlet ball valves and an ASME temperature and pressure relief valve. Entire assembly shall be pre-piped, assembled and skid mounted pressure tested and ready for installation.
- C. Components shall be as follows:

Circulating Pump: Pump shall be stainless steel and operate on a 120 volt, 60 cycle, 1 phase power supply (unless otherwise specified). The pump shall be wired to run with intermittent pump operation.

Storage Tank: Storage tank shall be the vertical, factory insulated type having a storage capacity of 80 gallons. The tank shall be constructed with an inner chamber designed to receive all circulation to and from the water heater to eliminate turbulence in the tank. The baffled tank shall supply 80% of tank capacity without a drop in outlet temperature.

The storage tank shall be constructed in accordance with Standard/ASME requirements, ASME, stamped and registered with the National Board of Boiler and Pressure Vessel Inspectors. The storage tank shall have a working pressure of (125/150) psi. The storage tank shall be glass lined and fired to 1600°F to ensure a molecular fusing of glass and steel, and carry a five (5) year limited warranty. The Lock-Temp Tank shall be constructed with a heavy gauge galvanized steel jacket assembly, primed and pre-painted on both sides. The jacket and tank base shall be a water tight construction with a built-in drain pan, complete with a 3/4" drain connection to assist in protecting against damage in the event of a tank or component leakage. The Storage Tank shall be completely encased in high density insulation of sufficient thickness to meet the energy efficiency requirements of the latest edition of the ASHRAE 90.1 Standard. The entire assembly shall be mounted on "I" beam skids to facilitate handling and installation.

The water heater heat exchanger shall have no banding material, bolts, gaskets or "O" rings in the header configuration. The stainless steel combustion chamber shall be designed to drain condensation to the bottom of the heat exchanger assembly. A built-in trap shall allow condensation to drain from the heat exchanger assembly. The complete heat exchanger assembly shall carry a five (5) year limited warranty.

The water heater shall be certified and listed by C.S.A. International under the latest edition of the harmonized ANSI Z21.10.3 test standard for the US and Canada. The water heater shall comply with the energy efficiency requirements of the latest edition of the ASHRAE 90.1 Standard. The water heater shall be AHRI certified to 96% thermal efficiency. The water heater shall be certified for indoor installation.

The water heater shall be constructed with a heavy gauge steel jacket assembly, primed and pre-painted on both sides. The combustion chamber shall be sealed and completely enclosed, independent of the outer jacket assembly, so that integrity of the outer jacket does not affect a proper seal. A burner/flame observation port shall be provided. The burner shall be a premix design and constructed of high temperature stainless steel with a woven metal fiber outer covering to provide modulating firing rates. The water heater shall be supplied with a gas valve designed with negative pressure regulation and be equipped with a variable speed blower system, to precisely control the fuel/air mixture to provide modulating water heater firing rates for maximum efficiency. The water heater shall operate in a safe condition at a derated output with gas supply pressures as low as 4 inches of water column.

The water heater shall utilize a 24 VAC control circuit and components. The control system shall have an electronic display for water heater set-up, water heater status, and water heater diagnostics. All components shall be easily accessed and serviceable from the front and top of the jacket. The water heater shall be equipped with; a high limit temperature control certified to UL353, ASME certified pressure relief valve, outlet water temperature sensor, inlet water temperature sensor, a UL 353 certified flue temperature sensor, low water flow protection and built-in freeze protection. The manufacturer shall verify proper operation of the burner, all controls and the heat exchanger by connection to water and venting for a factory fire test prior to shipping.

The water heater shall feature the “Smart System” control with a Multi-Colored Graphic LCD display with Navigation Dial and Soft Keys, password security, pump delay with freeze protection, pump exercise, and USB PC port connection. The water heater shall feature night setback for the domestic hot water tank and shall be capable of controlling a building recirculation pump while utilizing the night setback schedule for the building recirculation pump. The water heater shall have the capability to accept a 0-10 VDC input connection for BMS control of modulation or setpoint and enable/disable of the water heater, and a 0-10VDC output of water heater modulation rate. The water heater shall have a built-in cascading sequencer with modulation logic options of “lead lag” or “efficiency optimized”. Both modulation logic options should be capable of rotation while maintaining modulation of up to eight water heaters without utilization of an external controller. Supply voltage shall be 120 volt / 60 hertz / single phase.

The water heater shall be equipped with two terminal strips for electrical connection. A low voltage connection board with data points for safety and operating controls, i.e., Auxiliary Relay, Auxiliary Proving Switch, Alarm Contacts, Runtime Contacts, Manual Reset Low Water Cutoff, Flow Switch, High and Low Gas Pressure Switches, Tank Thermostat, Tank Sensor, Building Management System Signal, Modbus Control Contacts and Cascade Control Circuit. A high voltage terminal strip shall be provided for supply voltage. The high voltage terminal strip plus integral relays are provided for independent control of the Domestic Hot Water Pump and Building Re-circulation Pump.

D. Venting:

The water heater shall be installed and vented with a Direct Vent Sidewall system with a horizontal sidewall termination of both the vent and combustion air. The flue shall be PVC, CPVC or Stainless Steel sealed vent material terminating at the sidewall with the manufacturers specified vent termination. A separate pipe shall supply combustion air directly to the water heater from the outside. The air inlet pipe may be PVC, CPVC, ABS, Galvanized, Dryer Vent, or Stainless Steel sealed pipe. The air inlet must terminate on the same sidewall with the manufacturer's specified air inlet cap. The water heater's total combined air intake length shall not exceed 100 equivalent feet. The water heater's total combined exhaust venting length shall not exceed 100 equivalent feet. Foam Core pipe is not an approved material for exhaust piping.

E. Environmental:

The water heater shall have an independent laboratory rating for Oxides of Nitrogen (NOx) of 20 ppm or less, corrected to 3% O₂.

The water heater shall operate at altitudes up to 4,500 feet above sea level without additional parts or adjustments.

4.15 DOMESTIC WATER HEATING SYSTEM; ELECTRIC:

- A. Provide electric storage tank type domestic water heating system of model and capacity as indicated in the SCHEDULE on the Drawings. Units shall be as manufactured by A.O. Smith, Rheem or Rudd.
- B. Tank(s) shall have 150 psi working pressure and be equipped with extruded high density anode rod. All internal surfaces of the heater(s) exposed to water shall be glass-lined with an alkaline borosilicate composition that has been fused to steel by firing at a temperature range of 1600°F. Electric heating elements shall be medium watt density with zinc plated copper sheath.
- C. Each element shall be controlled by an individually mounted thermostat and high temperature cutoff switch. The outer jacket shall be of baked enamel finish and shall be provided with full size control compartment for performance of service and maintenance through hinged front panels and shall enclose the tank with foam insulation.
- D. Electrical junction box with heavy duty terminal block shall be provided.
- E. The drain valve shall be located in the front for ease of servicing.
- F. Heater tank shall have a three year limited warranty as outlined in the written warranty.

4.16 HOT WATER TEMPERING VALVE, THERMOSTATIC MIXING VALVE:

A. General:

Provide thermostatic mixing valves where indicated on the Drawings. Units shall consist of two (2) thermostatic controllers with check stops, removable cartridge with stainless steel piston and thermal motor and Turbulator™, inlet manifold piping, pressure reducing valve (PRV), two (2) pressure gauges, two (2) ball valves, bi-metal dial thermometer 3" (76mm) face, range 20 deg F–240 Deg F, connecting piping and fittings.

Hot Water Tempering Valves shall be as manufactured by Symmons, Leonard or Lawler.

B. Finish:

Standard rough bronze and copper finish.

Testing:

Factory assembled and tested.

C. Model:

Buildings A and B: Symmons 7-500-102PRV

D. Installation:

The thermostatic mixing valve must be piped in strict accordance with the manufacturer's recommendations.

4.17 ELEVATOR SUMP PUMP SYSTEM:

- A. General: Provide all labor, materials, equipment and incidentals required for complete elevator sump pump system with non-clog submersible centrifugal sewage pumps(s) as specified herein.

Capacity:	See Schedule
Model:	See Schedule
Manufacturer:	Hydromatic Pump, Ebarra, Myers

- B. The pump shall be capable of handling effluent from elevator sumps and shall include an oil sensing control capable of stopping the pump operation and posting an alarm signal in the event that oil or hydraulic fluid is sensed in the effluent.

The pump shall be non-overloading throughout the entire range of operation without employing service factor. The pump shall reserve a minimum service factor of 1.20. The performance curve submitted for approval shall state in addition to head and capacity performance, the pump efficiency and solid handling capability.

END OF SECTION 23 10 00

**SECTION 23 15 00
PLUMBING FIXTURES**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 01 and the following listed sections as a minimum, apply fully to work in this section.

Section 23 00 00 MECHANICAL GENERAL REQUIREMENTS

- B. Refer to and coordinate all work with the work of the following listed Sections:

Section 23 00 50 MECHANICAL: ELECTRICAL COMPONENTS

Section 23 10 00 PLUMBING

1.02 SCOPE:

- A. Provide labor, equipment and materials to complete the work indicated on drawings and herein specified.

1.03 RELATED WORK:

- A. Work in conjunction with this section shall be as designated below:

General Contractor:

Cutting, Patching, and Painting
Openings in roofs / Flashing
Openings in walls
Equipment foundations and bases
All temporary heating

Electrical Contractor:

Power wiring for electrical equipment provided within this section.

1.04 PROJECT ADMINISTRATION:

- A. Transmit questions, submissions, notices, and correspondence through the general contractor for transmittal to the Architect.
- B. Prepare and transmit to the Architect all submittal requirements within the time period allowed. See Schedule of Submissions.

1.05 SUBMITTALS:

- A. See SUBMITTAL GENERAL REQUIREMENTS within Section 23 00 00.
- B. The following shop drawings shall be prepared and submitted for approval within the time period stated (see SCHEDULE OF SUBMISSIONS in Section 23 00 00): (The list below is not intended to all inclusive. Provide submittals for all materials and equipment proposed for use on this project.)

Plumbing Fixtures
Fixture Trim

1.06 PROJECT CLOSE-OUT:

- A. Review and provide closeout requirements of this section and Section 23 00 00 Mechanical General Requirements, including:

Testing and Adjusting
Operating, Maintenance Instructions
Written Guarantee
Lubrication
Operating, Maintenance Manuals
Cleaning

PART 2 - FIXTURES AND INSTALLATION

2.01 FIXTURES: GENERAL

- A. The arrangement and quantity of plumbing fixtures shall be as indicated on the Architectural Drawings.
- B. Provide fixtures, carriers, brass and appurtenances complete with trimmings ready for use.
- C. Securely support fixtures from the building structure in a rigid manner. Provide hangers, frames, and carriers for proper installation. Wall hung fixtures shall be set tight to wall.
- D. Protect all fixtures during construction and thoroughly clean at project closeout.
- E. Air Gap: Provide only fixtures with an air gap between the level of supply openings and the level at the point of unrestricted external overflow.
- F. Domestic water hot and cold water supplies shall be arranged with cold on the right and hot on the left. Faucets shall be indexed to indicate H and C.

2.02 WATER FLOW RATE:

- A. General: Fixtures shall be limited to a flow rate of 1.6 gpm at 80 psig unless noted otherwise.

B. Public facilities:

Lavatories in restrooms of public facilities shall be equipped with faucet outlet devices that limit the flow to a maximum rate of .5 gpm.

Water closets shall use a maximum of 1.6 gallon per flushing cycle.

2.03 FIXTURES: MANUFACTURERS

A. General: Plate numbers and manufacturer's names used in the Schedule establish type and quality required.

B. Manufacturers:	Vitreous China	American Standard Kohler Toto
	Brass	Olympia Kohler Chicago Zurn Symmons Moen Delta
		American Standard
	Toilet seats	Church American Standard
	Shower Enclosure	Aquarius Lasco Aquabath
	Stainless steel sinks	Elkay Moen
	Electric Water Coolers	Elkay

2.04 FIXTURE INSTALLATION:

A. General: Review all drawings and determine the mounting locations and heights. All fixtures intended for handicapped use shall be mounted to suit requirements. Provide carriers and wall supports for the proper mounting height and type of construction indicated. For all exposed hot water piping and drains at fixtures provide insulation as specified and / or required.

B. Review the installation of all fixtures to insure proper clearances. If necessary, request additional detail data prior to the installation of fixtures.

2.05 FIXTURES: SCHEDULE

- A. Provide fixtures as indicated. Shop drawings are required. China fixtures are white unless indicated otherwise.

P-1 Water Closet: (Floor mounted, tank)

2462.100 "Cadet FloWize" floor mounted, vitreous china elongated bowl,
siphon action water closet with 15" high bowl, white, 1.1 GPF
5320.110 Ever Clean Round Front Seat with Slow Close Hinges
3/8" CP supply with stop

At locations where piping penetrates finished wall surfaces provide escutcheons, split casting, cast brass: Polished, chrome-plated finish with concealed hinge and setscrew.

Bolt hole covers
Wax ring gasket

P-2 Water Closet: (ADA, Floor mounted, tank)

2467.100 "Cadet FloWize Right Height" floor mounted, vitreous china elongated bowl,
siphon action water closet with 16-1/2" high bowl, white, 1.1 GPF
5320.110 Ever Clean Round Front Seat with Slow Close Hinges
3/8" CP supply with stop

At locations where piping penetrates finished wall surfaces provide escutcheons, split casting, cast brass: Polished, chrome-plated finish with concealed hinge and setscrew.

Bolt hole covers
Wax ring gasket

P-3 Lavatory: (Countertop)

Sink bowl integral to vanity top, provided by General Contractor. Provide connections and fittings as follows:

L-6052 Pioneer Industries - Olympia Single handle lavatory faucet, lift rod, flow control, waste. Polished Chrome Finish.

At locations where piping penetrates finished wall surfaces provide escutcheons, split casting, cast brass: Polished, chrome-plated finish with concealed hinge and setscrew.

3/8" CP angle supplies with stops
1-1/2" CP P-trap with clean out

P-4 Lavatory: (Countertop, ADA)

Sink bowl integral to vanity top, provided by General Contractor. Provide connections and fittings as follows:

L-6052 Pioneer Industries - Olympia Single handle lavatory faucet, lift rod, flow control,

waste. Polished Chrome Finish.

At locations where piping penetrates finished wall surfaces provide escutcheons, split casting, cast brass: Polished, chrome-plated finish with concealed hinge and setscrew.

3/8" CP angle supplies with stops

1-1/2" CP P-trap with clean out

Provide Handi-Lav-Guard insulation including angle valve and P-trap assembly.

Truebro Model #101

P-5 Shower: (5'-0")

Aquarius Model MP 6033 SH 5P L-R shower enclosure unit with integral blocking.
(Left or right as indicated on Drawings)

1-1/2" O D tailpiece and trap

1/2" Hot and Cold Water Supplies with stops

P-2370-T Pioneer Industries – Olympia single handle tub/shower trim set.

P2300-BB (valve)

P-6 Roll-In Shower Enclosure, Handicapped Use: (5'-0")

Aquarius Model MP 6033 BF 5P .75 Shower Enclosure (w/ integral blocking and removable grab bars), white. Left or right as indicated on Drawings.

1-1/2" O D tailpiece and trap

1/2" Hot and Cold Water Supplies with stops

P-2370-T Pioneer Industries – Olympia single handle tub/shower trim set.

P-4430 Pioneer-Olympia handheld shower sprayer

P-2270 Pioneer-Olympia diverter

P2300-BB (valve)

P-7 Kitchen Sink: (Stainless steel)

D-12521-1 Dayton single compartment 22 gauge type 304 stainless steel sink. 1 faucet hole.

K-5030 Pioneer Industries-Olympia Elite Single Handle Pull Out Kitchen Faucet

In-Sink-Erator 3/4 hp Evolution Compact Garbage Disposer

At locations where piping penetrates finished wall surfaces provide escutcheons, split casting, cast brass: Polished, chrome-plated finish with concealed hinge and setscrew.

1-1/2" P-trap with cleanout

Stop valves

P-8 Kitchen Sink: (Stainless steel, ADA)

D-12521-1 Dayton single compartment 22 gauge type 304 stainless steel sink. 1 faucet hole.

K-5030 Pioneer Industries-Olympia Elite Single Handle Pull Out Kitchen Faucet

In-Sink-Erator ¾ hp Evolution Compact Garbage Disposer

At locations where piping penetrates finished wall surfaces provide escutcheons, split casting, cast brass: Polished, chrome-plated finish with concealed hinge and setscrew.

1-1/2" P-trap with cleanout
Stop valves

P-8a Community Room Sink: (Stainless steel, ADA, Community Building)

D-12521-1 Dayton single compartment 22 gauge type 304 stainless steel sink. 1 faucet hole.

D150518BS Danze – Vaughn Single Handle Pull-Down Prep Faucet

In-Sink-Erator ¾ hp Evolution Compact Garbage Disposer

At locations where piping penetrates finished wall surfaces provide escutcheons, split casting, cast brass: Polished, chrome-plated finish with concealed hinge and setscrew.

1-1/2" P-trap with cleanout
Stop valves

P-9 Dishwasher Connections

Provide ½" hot water connection with ball valve. Reduce to connect to equipment with compression fittings.
Provide flexible pump discharge to side outlet at sink.

P-10 Mop Receptor:

MSB-2424 Fiat: Molded stone mop receptor with cast brass drain fitting and stainless steel strainer. #E-77-AA bumper guard. #231 White drift. 830-AA Service faucet with vacuum breaker

At locations where piping penetrates finished wall surfaces provide escutcheons, split casting, cast brass: Polished, chrome-plated finish with concealed hinge and setscrew.

832-AA Hose
889-CC Mop hanger

P-11 Clothes Washer Connection:

Provide connections as follows:
Floodmaster RS-090-E Washing Machine Leak Detection and Automatic Water Shut-Off
Outlet Box System, complete with the following features:

- Standard 120V wall plug power – no wiring required
- Water sensor with 8' lead wire
- Leak LED and audible alarm
- Integrated water hammer arrestors for hot and cold water lines
- 1/2" NPT brass fittings (supply line) and 3/4" NPT brass fittings (feed line)
- Outlet box with (4) mounting straps and trim plate
- Meets UL 94 5VA flammability standard

Mount 46-1/2" above floor to top.
1/2" supplies with stops
2" P trap

P-12 Drinking Fountain:

Elkay Model EZOOTL8WSSK, EZH20 Bottle Filling Station with Bi-Level ADA Cooler
Dual Hands Free Activation Refrigerated Stainless
3/8" CP angle supply with stop
1-1/2" PVC P-trap with clean out

P-13 Clubhouse Lavatory: (Wall-Mount, ADA)

K-2035-8 Kohler "Pinoir" Wall-mount lavatory

Moen T6920BL "Rizon" two handle widespread lavatory ADA faucet, lift rod, flow control,
waste. Polished Nickel Finish.

At locations where piping penetrates finished wall surfaces provide escutcheons, split
casting, cast brass: Polished, chrome-plated finish with concealed hinge and setscrew.

3/8" CP angle supplies with stops
1-1/2" CP P-trap with clean out

Provide Handi-Lav-Guard insulation including angle valve and P-trap assembly.

Truebro Model #101

P-14 Tub / Shower: (5'-0")

Aquarius S 6000 TS OT tub shower unit, (no grab bars) white. Left or right as indicated
on Drawings)

1-1/2" O D tailpiece and trap
1/2" Hot and Cold Water Supplies with stops
P-2370-T Pioneer Industries – Olympia single handle tub/shower trim set.
P2300-BB (valve)

END OF SECTION 23 15 00

**SECTION 23 30 00
FIRE PROTECTION**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 01 and the following listed sections as a minimum, apply fully to work in this section.

Section 23 00 00 MECHANICAL GENERAL REQUIREMENTS

- B. Refer to and coordinate all work with the work of the following listed Sections:

Section 23 00 50 MECHANICAL: ELECTRICAL COMPONENTS
Section 23 01 50 MECHANICAL: VIBRATION ISOLATION
Section 23 02 50 MECHANICAL: PIPE HANGERS AND SUPPORTS
Section 23 03 00 MECHANICAL: FIRE SAFING

Section 23 32 00 FIRE PROTECTION: SEISMIC RESTRAINT

1.02 SCOPE:

- A. Provide labor, equipment and materials to complete the fire protection work indicated on drawings and herein specified.
- B. See Division 31 - SITE UTILITIES, PIPING for work required beyond 5 ft from building wall.

1.03 RELATED WORK:

- A. Work in conjunction with this section shall be as designated below:

General Contractor: Cutting, Patching and Painting
Excavation
Flashing, counter flashing
Access panels/doors in walls, ceilings

Electrical Contractor: Wiring for electrical equipment provided within this section.
Alarm wiring, valve supervision wiring.

1.04 PROJECT ADMINISTRATION:

- A. Transmit questions, submissions, notices, and correspondence through the general contractor for transmittal to the Architect.
- B. Prepare and transmit to the Architect all submittal requirements within the time period allowed. See Schedule of Submissions.

1.05 SUBMITTALS:

- A. See SUBMITTAL GENERAL REQUIREMENTS within Section 23 00 00.
- B. The following shop drawings shall be prepared and submitted for approval within the time period stated (see SCHEDULE OF SUBMISSIONS in Section 23 00 00): (The list below is not intended to be all-inclusive. Provide submittals for all materials and equipment proposed for use on this project.)

- Pipe and fittings
- Hangers, supports, seismic bracing
- Valves
- Hose Valves / Pressure Reducers
- Check Valves
- Sprinkler heads
- Inspection Test Assembly / Floor Control Valves

- Wet System Alarm valve
- Alarm bell / Water motor gong
- Pressure gauge

- Backflow Preventer

- Fire Department connection

- Sight Glass

- All specialties

- C. The following submissions are to be made at or near project completion:

- Written Guarantee
- Inspection Certificates

1.06 SPRINKLER SYSTEM DRAWING SUBMITTAL:

- A. Submit for review complete fire protection data including:
 - Drawings indicating layout, sizing and elevation of all piping.
 - Manufacturer's brochures, including model numbers and specifications on all equipment.
 - Calculation data for hydraulic design.
- B. Submittal will be reviewed as to basic concept and layout, exact final pipe elevation and clearances, coordination with other trades, are to be field checked to insure proper coordination.
- C. Contract drawings indicate a general piping method for the project. All pipe routing and sprinkler head placement shall be coordinated by the Contractor, with the other trades and shall be approved by the Architect and Engineer prior to the installation of piping.
- D. Deviation from indicated layout shall be the Contractor's sole responsibility with regard to conflicts with other trades.
- E. Refer to PART 2 - SYSTEM DESIGN CRITERIA for additional requirements.

1.07 QUALIFICATIONS OF CONTRACTOR:

- A. None but a qualified fire protection contractor, licensed by the State, regularly engaged in the installation of automatic sprinkler systems, standpipes shall be accepted for this project.

1.08 SPECIAL APPROVALS REQUIRED:

- A. The Fire Protection Contractor shall prepare all drawings, plans, details and other requirements necessary for submission and approval of the fire insurance review agency.

1.09 SEQUENCE OF WORK:

- A. Prepare a written schedule or bar type graph for all required system shut downs or drain downs. Coordinate the required system shut downs with the Owner, the Owner's Insuring Agency, and all local authorities.
- B. Sequence the work such that installation will proceed with a minimum of system shut down.
- C. Provide the Architect and Owner with at least 24 hours notice before any system shut down.

1.10 PIPING: INSTALLATION

- A. General: Install pipe as indicated and specified herein. Arrange and install piping approximately as indicated, straight, pitched as required, and as direct as possible. Unless noted otherwise, conceal piping in building construction before erection of closing construction. When furred spaces are indicated, keep pipes as close to structural members as possible. Piping shall not interfere with openings, doors and windows. Allow for proper clearance at windows, doors, equipment and other building parts such that pipes does not interfere with access and building use.
- B. Piping shall be cut accurately to measurements established at the site and shall be installed without springing, forcing and excessive cutting or weakening of building structure. Pipes shall be installed in a manner permitting proper drainage and free expansion and contraction.
- C. Arrange piping passing through floors, walls and other partitions of building construction so that piping is centered in openings/sleeves and is rigidly supported on both sides of openings/sleeves. Provide flexible couplings at both sides of walls or floors, or oversized sleeves as required to conform to seismic isolation standards.
- D. Clean pipe, pipe fittings, and valves before erection. Cap or plug open ends of piping and equipment during construction to keep dirt and foreign material out of system.
- E. After threading steel pipe, clean pipe ends carefully to remove cutting oil and metal particles.
- F. Provide concrete thrust blocks for certain underground piping as shown on the Drawings. Provide concrete support pads under valves as shown on the Drawings.
- G. Unions or flanges shall be used to facilitate piping installation, and shall be installed between shut-off valves and equipment to facilitate removal of equipment for repair.
- H. Provide dielectric unions where pipes of dissimilar metals are joined together.

- I. Do not route pipelines over switchboards, panels, motor control centers, individual motor starters and/or other electrical equipment. Avoid routing pipelines over electrical raceways and bus ducts. If these locations cannot be avoided, provide drip pans under pipelines. Also provide drip pans where indicated on the Drawings. Drip pans shall be constructed of minimum 22 gauge stainless sheet metal with waterproof mastic applied to interior seams and joints. Pan width shall be minimum 2 times pipe diameter and with sides turned up minimum of 4" high and fitted with hemmed edge. Do not hang drip pans from pipe. Pitch pans minimum 1/8" per foot and provide 3/4" drain connection at low points. Pipe drains to nearest floor drain or as shown on the Drawings. All piping systems that are to be routed above or adjacent to electrical systems shall be reviewed with the local Electrical Inspector prior to installation.
- J. Swing Joints: Provide swing joints such that all sprinkler heads in ceiling tiles are located at the center of tiles unless indicated otherwise.
- K. Moveable Doors, Rollup Devices: Provide sprinkler heads under movable doors or other rollup devices that extend into the space more than 48".
- L. Suspended Equipment / Systems: Provide sprinkler heads under mechanical equipment and ductwork where coverage is required and the suspended item is larger than 48" x 48".
- M. Provide sprinkler cabinet with required number of sprinkler heads (containing all types of heads provided on the project) and sprinkler wrench.

1.11 CROSS AND INTER-CONNECTIONS:

- A. No piping for equipment, any device, or any apparatus internal connection shall be installed which will provide a cross or interconnection, under any circumstance of operation, between a distributing supply for drinking or domestic purposes and a not-potable supply or a drainage system or a soil or sanitary waste pipe which will permit or make possible the back-flow of sewage, polluted water or waste into the domestic water supply system.

1.12 COORDINATION WITH POWER DISTRIBUTION SYSTEMS:

- A. No piping for equipment, device or any apparatus internal connection shall be installed above any electrical power distribution panels or apparatus. Piping found to be installed contrary to this directive will be removed and relocated at no extra cost to the Owner.

1.13 SEISMIC SUPPORTS, HANGERS AND RESTRAINTS

- A. Provide all seismic supports, hangers and restraints as required:

See Section 23 32 00 FIRE PROTECTION: SEISMIC RESTRAINT SYSTEMS

1.14 INSPECTION AND TESTING

- A. Inspections, examinations and tests required by authorities/agencies shall be coordinated and paid for as necessary by the Fire Protection Contractor to obtain complete and final acceptance of the fire protection system. Transmit certificates of inspection, acceptance to the Architect.

1.15 PROJECT CLOSEOUT:

- A. Review and provide closeout requirements of this section and Section 15000 Mechanical General Requirements, including:

Testing and Adjusting
Record Drawings
Operating, Maintenance Instructions
Written Guarantee
Cleaning
Certificates of acceptance

PART 2 - SYSTEM DESIGN CRITERIA

2.01 GENERAL:

- A. The following Design Criteria has been prepared for use in the preparation of calculations and final design and installation shop drawings and details required for this project.
- B. The data contained herein has been based upon data as published by NFPA and as furnished by the Owner's Insuring Agent.

2.02 DESIGN AND INSTALLATION STANDARDS:

- A. NFPA National Fire Codes: Latest editions. Including but not limited to the following:

Standard No 13 - Sprinkler Systems, 2010 Edition
Standard No 13R - Standard for Installation of Sprinkler Systems in Residential Occupancies, 2010 Edition
Standard No 101 - Life Safety, 2012 Edition
Standard No 72 - National Fire Alarm Code, 2010 Edition

2.03 WATER SUPPLY DATA:

- A. Refer to the SCHEDULE on the Drawings for the water supply data that has been used for the preparation of the Fire Protection System Engineering Documents for this project.
- B. The Contractor shall arrange and carry all costs related to obtaining an up to date flow test for use in the preparation of the fire protection system shop drawings and hydraulic calculations.

2.04 FLOW REQUIREMENTS:

- A. Refer to the SCHEDULE on the Drawings for the system flow requirements to be used for this project.

2.05 WORKING PLANS: SPRINKLER SYSTEM SHOP DRAWINGS:

- A. Working plans shall be submitted for approval to the Architect/ Engineer and the authority having jurisdiction before any equipment is installed or remodeled.

- B. Working plans shall be drawn to an indicated scale, on sheets of uniform size, with a plan of each floor, and shall show those items from the following list that pertain to the design of the system (based upon NFPA-13, Chapter 22):

Name of owner and occupant

Location, including street address

Point of compass

Full height cross section, or schematic diagram, including structural member information if required for clarity and including ceiling construction and method of protection for nonmetallic piping

Location of partitions

Location of fire walls

Occupancy class of each area or room

Location and size of concealed spaces, closets, attics, and bathrooms

Any small enclosures in which no sprinklers are to be installed

Size of city main in street and whether dead end or circulating: if dead end, direction and distance to nearest circulating main; and city main test results and system elevation relative to test hydrant.

Other sources of water supply, with pressure or elevation

Make, type, model, and K-factor of sprinklers including sprinkler identification number

Temperature rating and location of high-temperature sprinklers

Total area protected by each system on each floor

Pipe type and schedule of wall thickness

Nominal pipe size and cutting lengths of pipe (or center-to-center dimensions). Where typical branch lines prevail, it shall be necessary to size only one typical line

Location and size of riser nipples

Type of fittings and joints and location of all welds and bends. The contractor shall specify on drawing any sections to be shop welded and the type of fittings or formations to be used

Type and locations of hangers, sleeves, braces, and methods of securing sprinklers when applicable

All control valves, check valves, drain pipes, and test connections

Make, type, model, and size of preaction of deluge valve

Kind and location of alarm bells.

Size and location of standpipe risers and related equipment

Private fire service main sizes, lengths, locations, weights, materials, point of connection to city main; the sizes, types and locations of valves, valve indicators, regulators, meters, and valve pits; and the depth that the top of the pipe is laid below grade

Piping provisions for flushing

For hydraulically designed systems, the information on the hydraulic data nameplate

A graphic representation of the scale used on all plans

Name and address of contractor

Hydraulic reference points shown on the plan that correspond with comparable reference points on the hydraulic calculation sheets

The total quantity of water and the pressure required noted at a common reference point for each system

Relative elevations of sprinklers, junction points, and supply or reference points

If room design method is used, all unprotected wall openings throughout the floor protected

Calculation of loads for sizing and details of sway bracing

The setting for pressure-reducing valves

Information about backflow preventers (manufacturer, size, type)

Size, location, and piping arrangement of fire department connections

- C. The working plan submittal shall include the manufacturer's installation instructions for any specially listed equipment, including descriptions, applications, and limitations for any sprinklers, devices, piping, or fittings

2.06 HYDRAULIC CALCULATION STANDARDS:

- A. General: Hydraulic calculations shall be prepared on form sheets that include a summary sheet, detailed worksheets, and a graph sheet.
- B. Summary Sheet: The summary sheet shall contain the following information, where applicable (Based upon NFPA-13, Chapter 22):

Date

Location

Name of owner and occupant

Building number or other identification

Description of hazard

Name and address of contractor or designer

Name of approving agency

System design requirements, as follows:

Design area of water application, ft² (m²)

Minimum rate of water application (density), gpm/ft² (mm/min)

Area per sprinkler, ft² (m²)

Total water requirements as calculated, including allowance for inside hose, outside hydrants, and water curtain and exposure sprinklers

Limitations (dimension, flow, and pressure) on extended coverage or other listed special sprinklers

C. Detailed Worksheets:

Detailed worksheets or computer printout sheets shall contain the following information:

Sheet number

Sprinkler description and discharge constant (*K*)

Hydraulic reference points

Flow in gpm (L/min)

Pipe size

Pipe lengths, center-to-center of fittings

Equivalent pipe lengths for fittings and devices

Friction loss in psi/ft (bar/m) of pipe

Total friction loss between reference points

Elevation head in psi (bar) between reference points

Required pressure in psi (bar) at each reference point

Velocity pressure and normal pressure if included in calculations

Notes to indicate starting points or reference to other sheets or to clarify data shown
Diagram to accompany gridded system calculations to indicate flow quantities and directions for lines with sprinklers operating in the remote area

Combined K-factor calculations for sprinklers on drops, armovers, or sprigs where calculations do not begin at the sprinkler

D. Graph Sheet:

A graphic representation of the complete hydraulic calculation shall be plotted on semi-exponential graph paper (Q 1.85) and shall include the following:

- Water supply curve
- Sprinkler system demand
- Hose demand (where applicable)

2.07 ADDITIONAL REQUIREMENTS:

- A. The fire protection system shall be designed and installed in strict accordance with the requirements of NFPA and Factory Mutual.
- B. Coordinate the exact location of all materials with the other trades and with the building components prior to installation.
- C. Sprinkler heads, hose racks and fire protection system piping shall be installed allowing proper clearances from mechanical, plumbing, structural and rack system components. Proper clearances shall be as per NFPA 13. Maintain maximum space conditions at all points. Where space conditions appear inadequate, notify the Architect before proceeding with the installation.
- D. Provide swing joints and piping offsets as required for installation of the sprinkler heads in the locations required.
- E. Sprinkler heads within finished ceiling areas (i.e., office spaces, computer room) shall be spaced and installed for location at the center of ceiling tiles unless specifically indicated otherwise.
- F. Refer to the Fire Alarm Drawings for alarm annunciation required.
- G. Drain valves shall be provided at all trapped sections of the fire protection systems where required by NFPA-13. Drain valves shall be sized as per NFPA 13.
- H. Inspector's Test Connections shall be provided at each zone of alarm annunciation. Pipe test pipe discharge to the building exterior as directed by the Architect.
- I. All system shut off valves shall be fitted with valve tamper switches. Location and service of all valve switches shall be coordinated with the fire alarm system.
- J. Minimum end head pressures as indicated include a minimum design cushion of 10 psig.
- K. Provide sprinkler cabinet with required number of sprinkler heads (containing all types of heads provided on the project) and sprinkler wrench.

PART 3 - PRODUCTS AND INSTALLATION

3.01 GENERAL:

- A. Provide new, standard products, materials and equipment which comply with the specification; are undamaged and unused at the time of installation; are complete with accessories, trim, finish,

safety guards and other devices and details needed for a complete installation and for the intended use.

3.02 PIPING: GENERAL

- A. General: Install pipe as indicated and specified herein. Pipe shall properly pitch, plumb and true to building parts as is the best practice of the trade.
- B. Welding: Welding, brazing, soldering shall be with proper regard for fire prevention and safety. See Fire Watch requirements.
- C. Clearances: Allow for proper clearance at windows, doors, equipment and other building parts such that pipe does not interfere with access and building use.
- D. Protection: During the construction phase provide temporary caps, plugs at all open ended unattended piping.

3.03 PIPING: ABOVE GRADE, WET SYSTEMS:

- A. Material: 2" and larger piping - Steel pipe ASTM A120 "thin wall", 1-1/2" and smaller piping shall be Schedule 40 steel pipe. Roll grooved Victaulic couplings are allowed.
- B. Joints: Piping 2" and larger shall be with Victaulic Style 009N Rigid, or 004/75 Flexible grooved couplings designed for the application. Piping 1-1/2" and smaller shall be with standard screw joints and cast iron 175 psi fittings. Apply approved joint compound or tape to male threads only. Roll grooving Sch.40 1 1/2" pipe, will be allowed.
- C. Test: Apply hydrostatic test of 200 psig, or 50 psi above normal working pressure (whichever is greater) for a period of 2 hours with a loss of pressure of less than 5 psig, and with no apparent leakage.
- D. Flanged Connections: At equipment, appurtenances, and valves 2-1/2" and larger provide connections with 150 pound weldneck flanges complete with Johns-Mansville ring gaskets and U S Standard machine bolts, washers and nuts.
- E. Installation: Cut pipe accurately and install without springing or forcing and allow for proper clearance from all building components. Remove burrs and ream pipe prior to installation and allow for free pipe expansion without damage.

3.04 PIPING: CONCEALED ABOVE CLGS, WET SYSTEMS, 2" and SMALLER, CPVC: *(Alternate for Contractor's Option)*

A. CPVC Pipe:

BlazeMaster CPVC sprinkler pipe shall be produced in SDR 13.5 dimensions in accordance to the requirements of ASTM F442, UL Listed and FM Approved for services to 175 psi (1205 kPa) at 150° F (66°C), and approved per the National Sanitation Foundation (NSF-pw) for potable water service.

B. CPVC Fittings:

BlazeMaster CPVC fittings shall be produced in accordance to the requirements of ASTM F437, F438, and F439, UL Listed and FM Approved for services to 175 psi (1205 kPa) at 150°F (66°C), and approved per the National Sanitation Foundation (NSF-pw) for potable water service.

C. CPVC One-Step Solvent Cement:

BlazeMaster CPVC Fire Sprinkler One-Step Solvent Cement shall be beige in color, contain low VOC's, and shall be used to join all FireLock products eliminating the need for primers typical of two-step cementing processes.

D. Application of BlazeMaster CPVC Products in wet pipe fire sprinkler systems:

BlazeMaster CPVC Fire Sprinkler Products, when installed in accordance with manufacturer's installation instructions, are UL listed for use in the following: Light Hazard Occupancies as defined in NFPA 13, Residential occupancies up to and including four stories in height per NFPA 13R, and in One and Two Family Dwelling and Manufactured Homes per NFPA 13D. They shall meet the combustibility requirements for use in return air plenums per NFPA 90A. Other listings include garages per NFPA 13R, system risers to NFPA 13R and 13D, exposed installations, and underground fire service per ASTM D2774, ASTM F645, and NFPA 24. BlazeMaster CPVC Fire Sprinkler Products shall be approved by Factory Mutual for use in unexposed, non-removable, fire-resistant barriers as defined in NFPA 13, 13R, 13D and NFPA 24.

E. Applications of BlazeMaster CPVC Products in potable water system:

BlazeMasterCPVC Fire Sprinkler Products shall meet all applicable performance standards for a pressure rated application as required in ANSI-NSF Standard 14, comply with ANSI-NSF Standard 61 for health effects, and shall be marked with the NSF-pw end use marking.

Installation of BlazeMaster CPVC Fire Protection Products:

Installation shall be in strict accordance with Victaulic FireLock CPVC Fire Sprinkler System Design and Installation Manual including product storage and handling, joining methods, supporting and bracing, expansion and contraction allowance, and testing etc.

Test: Apply hydrostatic test of 200 psig, or 50 psi above normal working pressure (whichever is greater) for a period of 2 hours with a loss of pressure of less than 5 psig, and with no apparent leakage.

3.05 DUCTILE IRON PIPE: BELOW GRADE:

A. Products, General:

The Contractor shall furnish and install Ductile Iron Pipe and all appurtenances, complete in place, all in accordance with the requirements of the Contract Documents. Where standards, specifications or methods are cited without dates, the reference shall be construed to apply to the latest revision in effect at the time of contract.

The term "Manufacturer" shall mean the party that manufactures, fabricates, or produces materials or products.

B. Codes, and Standards:

ANSI/AWWA C104/A21.4 Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
ANSI/AWWA C105/A21.5 Polyethylene Encasement for Ductile-Iron Pipe Systems
ANSI/AWWA C110/A21.10 Ductile-Iron and Gray-Iron Fittings, 3-in through 48-in for Water and Other Liquids
ANSI/AWWA C111/A21.11 Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
ANSI/AWWA C115/A21.15 Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges
ANSI/AWWA C150/A21.50 Thickness Design of Ductile-Iron Pipe
ANSI/AWWA C151/A21.51 Ductile-Iron Pipe, Centrifugally Cast for Water
ANSI/AWWA C153/A21.53 Ductile-Iron Compact Fittings, 3-in through 24-in and 54-in through 64-in for Water Service
ANSI/AWWA C600 Installation of Ductile-Iron Water Mains and their Appurtenances
ANSI/AWWA C606 Grooved and Shouldered Joints
ANSI/AWS D11.2 Guide for Welding Iron Casting

Note: Hereafter in this specification the specific referenced ANSI/AWWA standards are referred to either by their full description as in the first column of the above standards list, or only by their abbreviated AWWA "C" designation (e.g. AWWA C151 is meant to refer to ANSI/AWWA C151/A21.51, etc.).

C. Submittals:

Shop Drawings/Lay Schedules: The Contractor shall submit catalog cuts of pipe and fittings as follows:

Certified dimensional drawings of all valves, fittings, and appurtenances.
Certified dimensional drawings of joints, showing the manufacturer's allowable deflections.

Copies of the manufacturer's approved installation instructions for the types of joints being used.

Certifications: Upon request the Contractor shall furnish a certified affidavit of compliance for all pipe and other products or materials furnished under this Section, as specified in the referenced standards and as specified under Quality Assurance.

D. Quality Assurance:

Inspection: All pipe shall be subject to inspection at the place of manufacture, in accordance with the provisions of the referenced standards, as supplemented by the requirements herein.

Tests: All piping and joint material shall be factory proof tested.

Affidavits: Upon request the CONTRACTOR shall submit affidavits of compliance from the MANUFACTURER for the following: (The affidavits of compliance shall be certified by a registered professional engineer.)

Ductile iron pipe in accordance with the requirements of AWWA C151 and these specifications.
Cement-mortar lining of ductile iron pipe, specials and fittings in accordance with the requirements of AWWA C104 and these specifications.

Polyethylene encasement for ductile iron piping in accordance with AWWA C105 (if specified).

Rubber gasket joints for ductile iron pressure pipe and fittings in accordance with the requirements of AWWA C111 and these specifications.

Charpy impact testing of ductile iron used in the manufacture of pipe shall be performed in accordance with AWWA C151.

The minimum corrected absorbed energy (ft.-lb.) shall be as follows: 7 ft.-lb. at 70o F + 10o F

Low-temperature impact tests shall be made from at least 10% of the test pipe to assure compliance.

The minimum corrected absorbed energy (ft.-lb.) shall be as follows: 3 ft-lb at -40° F(° C)

E. Products, General:

Standards: Ductile iron pipe shall conform to AWWA C151, subject to the following supplemental requirements. The pipe shall be of the diameter and class shown, shall be furnished complete with rubber gaskets as indicated in the Contract Documents, and all specials and fittings shall be provided as required under the Contract Documents. The ductile iron pipe, specials, and fittings shall be manufactured or supplied by American Ductile Iron Pipe (a division of American Cast Iron Pipe Company, Birmingham, Alabama) or pre-approved equal.

Markings: Upon request, the CONTRACTOR shall require the MANUFACTURER to legibly mark specials in accordance with the laying schedule and marking diagram.

Laying Lengths: Pipe laying lengths shall be provided in 20-foot nominal lengths with allowable trim pipe lengths in accordance with AWWA C151 and special shorter lengths provided as required by the Drawings.

F. Pipe Design:

Design Parameters: All ductile iron pipe shall be designed and manufactured in accordance with AWWA C150 and AWWA C151, respectively, for the following minimum operating conditions:

The minimum internal design pressure shall be 150 psi with a 100-psi surge allowance, with a safety factor of 2, for a total internal design pressure of 500 psi. No reduction of safety factor for transient pressures shall be allowed.

The horizontal deflection of cement-mortar lined ductile iron pipe resulting from external load conditions shall not exceed 3% of the pipe diameter.

G. Joint Design:

General: Ductile Iron Pipe and fittings shall be furnished with push-on joints, push-on restrained joints, mechanical joints, flanged joints, and grooved joints as required.

Push-on Joints: Push-on joints shall conform to AWWA C111. Unless otherwise specified gasket material shall be standard styrene butadiene copolymer (SBR). Push-on joints shall be Fastite, as manufactured by American Ductile Iron Pipe, or pre-approved equal. The pressure rating for push-on joints shall be a minimum of 350 psi or the specified pressure rating of the pipe, whichever is less.

Restrained Joints: Restrained joints shall be "Flex-Ring" or "Lok-Ring" restrained joints as manufactured by American Ductile Iron Pipe or pre-approved equal. Field-adaptable restraint shall be provided through the use of "Fast-Grip" or "Field Flex-Ring" as manufactured by American Ductile Iron Pipe, or other pre-approved and bolt-less, push-on restrained devices. When restrained joints require factory welding, the Manufacturer shall qualify all welding procedures and welders used to produce the product per the requirements of a documented quality assurance system based on ANSI/AWS D11.2. Unless otherwise specified, gasket material shall be standard styrene butadiene copolymer (SBR). Restrained joints and restrained joint pipe shall be rated for

the specified pressure rating of the pipe. The Manufacturer shall furnish test results showing that restrained joints in the sizes specified have been successfully tested to at least twice the specified pressure rating of the joint without leakage or failure. Tests shall be performed on pipe with nominal metal thickness less than or equal to that specified for the project. Torque-activated restrained joint devices that rely on threaded bolts or set-screws for joint restraint shall not be used.

Flanged Joints, Fittings: Flange fittings shall be ductile iron in accordance with AWWA C110 or AWWA C153, not ANSI B16.1. Bolt circle and bolt holes match those of ANSI B16.1 class 125 and ANSI B16.5 class 150 flanges. The flanges shall be rated for at least 250 psi working pressure. Bolts, gaskets and installation shall be in accordance with AWWA C110 or AWWA C115, Appendix A requirements, and flanged gaskets shall be NSF 61 certified Toruseal® gaskets as manufactured by American Ductile Iron Pipe, with a special seal design. NSF 61 certified Toruseal® gaskets must be used for buried flanged joints. Gaskets shall be full face NSF 61 certified Toruseal® design for all service installations. Gaskets for flanged ductile iron pipe must not have the larger inside diameters provided by the requirements of ANSI B16.21. Flange facing shall be smooth or with shallow serrations per AWWA C110 or AWWA C153.

Mechanical Joints: Mechanical joints shall conform to AWWA C111. Bolts shall be high-strength, low-alloy steel per AWWA C111. Unless otherwise specified, gasket material shall be standard styrene butadiene copolymer (SBR) per this standard.

Grooved Joints: Unless specifically otherwise called for on the contract drawings, grooved joints shall be an approved substitute for flanged joints. Grooved pipe and groove joints shall be in accordance with AWWA C606. Rigid radius groove dimensions shall be utilized. Flexible grooves shall be provided as necessary for settlement or expansion as determined and approved by the Engineer and as specifically shown on the contract drawings. Gasket material shall be Grade "M" halogenated butyl. Bolts shall be heat-treated plated carbon steel, track head, conforming to the physical properties of ASTM A-183, minimum tensile strength 110,000 psi. Grooved ductile iron pipe shall be Special Thickness Class 53 for 4" – 16". Victaulic Style 31 coupling.

H. Fittings:

General: Fittings shall be ductile iron in accordance with AWWA C110, AWWA C153, or AWWA C606, latest revisions.

Cement Lining: Fittings shall be internally lined with cement mortar in accordance with AWWA C104. The lining thicknesses shall be equal to or greater than those for comparable size pipe.

Buried Service Fittings: Fittings, sizes 4" – 24", with push-on, restrained push-on, or mechanical joints shall be rated for 350 psi working pressure.

Aboveground Service Fittings: Fittings, sizes 4" – 64", with flanged joints shall be rated for 250 psi working pressure. Fittings, sizes 4" – 36", with grooved joints shall be rated for 250 psi working pressure. Grooved couplings shall be rated for 250 psi working pressure for 4" – 18".

I. Cement-Mortar Lining:

Cement-Mortar Lining for Shop Application: Except otherwise provided herein, interior surfaces of all ductile iron pipe, fittings, and specials shall be cleaned and lined in the shop with a standard thickness cement-mortar lining applied in conformity with AWWA C104, Portland cement mortar. Every precaution shall be taken to prevent damage to the lining. If lining is damaged or found faulty at delivery site, the damaged or unsatisfactory portions shall be repaired or replaced with lining conforming to these Specifications.

J. Exterior Coating:

Buried Ductile Iron Pipe: The exterior of ductile iron pipe, special, and fittings shall be coated with a 1-mil asphaltic coating in accordance with AWWA C151, Section 51-9. When specified, loose polyethylene encasement shall be supplied in accordance with AWWA C105.

Aboveground Ductile Iron Pipe: Interior, Exterior, or Immersion Placement, Aggressive Exposure: The exterior of ductile iron pipe, specials, and fittings shall be coated suitable to allow ACIPCO Primer No. 2 High Solids Epoxy or TNEMEC 140-1211 shall be NSF 61 certified for use in potable water systems. Shop coat thickness: 3.0-8.0 mils dry film thickness

3.06 VALVES:

- A. Provide O S & Y flanged gate type valves as indicated.

Walworth 8713-F
Kennedy 68
Victaulic grooved end OS&Y Gate Valve 771H is allowed.

- B. Valves shall be UL and FM listed and shall be complete with supervision device for connection to the alarm system. System Sensor Style OSY2.

3.07 VALVES: BUTTERFLY TYPE:

- A. Provide gear operated butterfly valves as indicated.

Victaulic Figure 705W
Kennedy Figure 911

- B. Valves shall be UL and FM listed and shall be complete with supervision device for connection the alarm system.

3.08 VALVES: CHECK VALVE:

- A. Provide Ductile-iron, grooved-end check valve, with taps upstream and downstream for ball drip connection for fire department connection.

Victaulic Series 717.

3.09 PRESSURE GAUGE:

- A. Provide 3-1/2" dial type pressure gauge, P1590 as manufactured by Ametek - U S Gauge at the new fire service connection and at the top of the standpipe riser. Provide gate valve at pressure gauge.

3.10 FLOW SWITCHES:

- A. Provide flow switches with flow paddle, adjustable pneumatic retard and two single pole/single throw microswitches to operate separate circuits, 120V A.C. Flow switches shall be approved for

fire protection, System Sensor, Potter Electric or engineer approved equal. Coordinate switching requirements with fire alarm system.

3.11 VALVE SWITCHES:

- A. Provide valve switches with two single pole/double throw microswitches to operate separate circuits, 120V A.C. Valve switches shall be installed at all system shut off and isolation valves, and approved for fire protection systems, System Sensor, Potter Electric or engineer approved equal. Coordinate switching requirements with fire alarm system.

3.12 PIPE SUPPORTS AND HANGERS:

- A. Pipe supports and hangers shall be installed in accordance with NFPA Standard No 13 - Section 3-4.

3.13 PIPE SLEEVES:

- A. Walls: Provide steel pipe sleeve where fire protection piping passes through masonry walls. Sleeves shall be flush with wall.
- B. Floors: Provide steel pipe sleeves where fire protection piping passes through concrete floors. Extend sleeve 1/2" above finished floor.

3.14 FIRE STOPS:

- A. All pipes passing through fire rated floor and wall assemblies shall be sealed with glass wool to completely seal opening. Sleeves shall be packed full depth. Refer to Section 23 03 00-Mechanical: Fire Safing.

3.15 INSPECTOR'S TEST CONNECTION:

- A. Provide 1" test piping equipped with 1" globe valve as indicated;

Jenkins	#106-A,
Walworth	#95,
Nibco	#T-235-Y,
Victaulic	#720 Testmaster II

- B. Provide test orifice and site drain where required to test flow switches and alarm system.

3.16 FLEXIBLE SPRINKLER RUNOUTS:

- A. General: Provide flexible piping connections to sprinkler heads for both suspended and sheetrock ceilings. All flexible piping systems shall be UL Listed and FM Approved and suitable for their intended use.
- B. All flexible piping connections to include a fully welded (non-mechanical fittings), braided, leak-tested sprinkler drop with a minimum internal corrugated hose diameter of 1 inch; and a one-piece multi-port ceiling bracket with removable attachment hub and self-securing integrated snap-on clip-ends, for attachment to ceiling grid without the need for a screw fastener.

- C. Flexible runouts shall be of length between 2'-0" and 6'-0" as required.
- D. Multiple-Use Flexible Drop System: In lieu of rigid pipe offsets or return bends for sprinkler drops, the Victaulic VicFlex™ Multiple-Use Flexible Stainless Steel Sprinkler Drop System may be used to locate sprinklers as required by final finished ceiling tiles and walls. The drop system shall consist of a braided type 304 stainless steel flexible tube, zinc plated steel 1" NPT Male threaded nipple for connection to branch-line piping, and a zinc plated steel reducer with a 1/2" or 3/4" NPT female thread for connection to the sprinkler head.
- E. The drop shall include a UL approved Series AH2 braided hose with a bend radius to 2" to allow for proper installation in confined spaces. The hose shall be listed for [(4) bends at 31" length] [(5) bends at 36" length] [(6) bends at 48" length] [(6) bends at 60" length] [(7) bends at 72" length].
- F. Union joints shall be provided for ease of installation. The flexible drop shall attach to the ceiling grid using a one-piece open gate Series AB1 bracket. The bracket shall allow installation before the ceiling tile is in place. The braided drop system is UL listed and FM Approved for sprinkler services to 175 psi (1206 kPa).

3.17 SPRINKLER HEADS:

- A. Refer to the SCHEDULE on the Drawings for the model and type of sprinkler heads to be used for this project.
- B. Provide sprinkler cabinet with required number of sprinkler heads (containing all types of heads provided on the project) and sprinkler wrench.

3.18 SYSTEM APPURTENANCES:

- A. Provide as follows:

Check Valve:	#1365 ITT Grinnell
Alarm Bell:	12" electric alarm bell and label.

3.19 FIRE DEPARTMENT CONNECTION: SIDEWALL

- A. Provide complete Fire Department Connection (FDC) where indicated on drawings.

Manufacturer:	Potter-Roemer, Inc. or approved equal
Model:	5721-B // 2-1/2 x 2-1/2 x 4
Finish:	Plain brass
Label:	"Automatic Sprinkler".

- B. The two hose connections shall have threads as approved by local fire authorities and be equipped with caps and chains.

3.20 ALARM VALVE: WET SYSTEM

- A. Provide flanged connection alarm check valve as indicated and as follows:

Victaulic Style 751 Ductile-iron alarm valve, grooved end, UL/FM approved to 300 PSI, complete with by-pass, gauges and main drain.

3.21 FREESTANDING TYPE POST INDICATOR VALVE:

- A. Provide wall type post indicator valves for fire department use as follows:

Valve: Non-rising stem flanged gate valve, UL Listed & FM approved. Kennedy Fig #701X or Victaulic Series 772H. Or engineer approved equal.

Indicator Post: Victaulic Series 774 UL/FM indicator post for vertical sidewalk / site mounting. Indicator post shall be complete with extension drive, handwheel and indicator plates. All working parts shall be completely enclosed for weather protection. Provide geared offsets in drive as required.

Locking Device: Operating handwheel shall be fitted with locking staple to prevent operation of handwheel.

Valve Switch: Valve shall be fitted with a valve tamper switch. Tamper switch shall be suitable for interface with the building fire alarm system.

Installation: Locate as detailed on the Contract Drawings.

3.22 BACKFLOW PREVENTER: DOUBLE CHECK

- A. General: Provide backflow preventer at all fire service entrance connections to the public water supply. Backflow preventers shall carry the approval of the ASSE, UL and FM.
- B. Backflow prevention systems shall be of two independently operated check valves, two shut off OS&Y valves, and four test cocks.

Manufacturer: Ames Company
Model: Colt Series C200

- C. Check valves shall be housed within a single stainless steel body, and shall be removable and serviceable. Valves shall be of Tri Link design.
- D. The backflow preventer assembly shall be housed between two UL/FM resilient seated O.S.&Y gate valves. Bronze body ball valve test cocks shall be provided upstream, downstream and between the check valves.

PART 4 - SYSTEM INSTALLATION

4.01 GENERAL:

- A. The contract drawings intend to show only the scope of the design. The Fire Protection Contractor shall be responsible for the correct installation of this work in a manner satisfactory to the best practices of his trade and to complete the scope of this subcontract in all respects. All roughing to equipment shall be accomplished in all details to Specifications of equipment manufacturer and to approval of Architect. No work shall be accomplished until the pertinent manufacturer's shop drawings are approved.
- B. The location of piping as indicated on the Drawings, unless otherwise noted, is diagrammatic only, and the exact locations shall be determined in the field. The run and arrangement of all pipes shall be approximately as shown on the Drawings, as directed during installation, in strict accordance with NFPA Pamphlets Standards, and as straight and direct as possible, forming right angles or parallel lines with building walls and other pipes, and neatly spaced. All risers and standpipes shall be erected true and plumb, parallel with walls and other pipes, and neatly spaced. All horizontal runs of piping, except where concealed in partitions, shall be kept as high as possible and close to walls. Where possible, adjacent pipe lines, and fire protection piping, shall be grouped in the same vertical or horizontal planes. All piping shall be concealed where required and concealed piping shall have a minimum number of fittings. Piping shall not interfere with the operation or accessibility of doors, windows, access panels, valves, H & V unit access, air flow patterns, or equipment, and shall not encroach on aisles or passageways. All piping shall be installed to preserve access to all valves, drains and equipment. Pipe will not be permitted to pass through footings, beams or ribs. Make such offsets and deviations from the Drawings as may become necessary to meet actual field conditions.
- C. The Fire Protection Contractor shall be responsible for the correctness of field dimensions and shall check for himself all grades, lines, measurements, and other data in any way affecting his work. He shall refer to the project phasing schedule together with architectural and structural drawings of other trades for a full comprehension of the extent of the work to be performed and to avoid interference. He shall not be entitled to any extra compensation for any additional work or expense arising from his failure to do so. In case interference develops the Architect shall decide which work is to be relocated, regardless of which was first installed. Work installed by The Fire Protection Contractor which is improperly located and/or interferes with or modifies either the phasing schedule or the architectural or structural design, shall be changed as directed by the Architect, and all costs incidental to such changes shall be paid by The Fire Protection Contractor.
- D. The Fire Protection Contractor shall coordinate all his work with the work of all other trades, and shall so arrange his work that there will be no delay in the proper installation and completion of any part or parts of each respective work wherein it may be interrelated with his, so that generally all construction work can proceed in its natural sequence without unnecessary delay, close coordination is also required with the HVAC, plumbing and electrical contractors in areas serving these trades.
- E. Contact between piping and dissimilar metals such as hangers, building structural work, or equipment shall be avoided to prevent galvanic action.
- F. Pipe shall be cut accurately to measurements established at the site and shall be worked into place without springing or forcing. All pipe, regardless of how cut throughout the job, shall be reamed smooth and all burrs removed before being installed. Pipe shall not be split, bent, flattened, nor otherwise injured either before or during the installation. Full lengths of pipes shall be used wherever possible and short lengths of pipe connected with couplings will not be permitted.

- G. The Fire Protection Contractor shall use every precaution in the installation of all piping to prevent dirt, chips, or other foreign materials entering the inside of piping. All pipes shall be clean and blown out to the satisfaction of the Architect before closing of any line. Keep the ends of piping capped or blind flanged during the construction of the system to keep out dirt or other foreign matter. The plugs and caps are to remain until permanent and final installation is made. The use of paper, waste, rags and so forth to close openings will not be permitted.
- H. Unions or flanges shall be installed at all equipment valves and at such other places as may be necessary to disconnect piping or at each piece of equipment or accessory which may have to be disconnected to make repairs.
- I. Bushing will not be inserted in fittings for reduction in size where fittings of required size are manufactured.
- J. The Fire Protection Contractor shall also provide the necessary data and supervision for the provision of all holes in the structure, and also for the installation of equipment foundations, including bolt hole templates, weights and manufacturer's recommendations for proper emplacement design.
- K. Equipment and accessories shall be set level, plumb and in proper alignment with reference to adjacent walls. All surfaces coming in contact with walls, floors or other equipment shall have properly planed surfaces with suitable contact on wall and floors.
- L. Clips, hangers, clamps, supports and other attachments to surfaces to be fireproofed shall be installed, insofar as possible, before start of spray fiber work. Piping and equipment that interfere with proper application of fireproofing shall be installed after completion of spray fiber work. Patch and repair spray fireproofing cut or damaged during course of work specified under this Section. Trade responsible for damage shall bear cost of repair.

4.02 INSTALLATION REQUIREMENTS:

- A. The contractor shall comply with all the rules, Codes, Ordinances, regulations and requirements, of all legally constituted Authorities Having Jurisdiction over the whole or any part of the work herein specified and shall also comply with all applicable requirements of IRI and these specifications. These requirements are minimum criteria and no reductions permitted by Code will be allowed without written permission of the Architect.
- B. All equipment and materials furnished in connection with the installation shall be new and furnished in accordance with the requirements of this specification and they shall be of the best grade and quality of their respective kinds, free from natural, manufacturing or construction flaws, defects or irregularities and finish, fittings and workmanship shall be equal to the highest commercial grade.
- C. Castings of all metals, of all kinds, shall be clean, smooth, close grained, of uniform thickness and free from all defects such as sandholes, blisters or cracks.
- D. Before the installation will be accepted, the contractor shall have every portion of his work in a first-class working condition.

- E. Where planning the installation of any of the apparatus herein called for, sufficient clearance shall be allowed to permit the removal and replacing of parts that may require future removal for repairs and replacement.

4.03 TESTING AND INSPECTION:

- A. The Fire Protection Contractor shall obtain and pay for all inspections and tests required for this Section of the work. Defects discovered in work, materials and/or equipment shall be replaced by the Fire Protection Contractor at no cost to the Owner, and the inspection and test shall be repeated. When work is completed, this Contractor shall furnish a Certificate of Inspection and Approval to the Owner before final payment of the Contract will be allowed.
- B. Test sprinkler and standpipe piping and make watertight before painting and before concealment. Make partial tests as required, during the progress of the work. All tests shall be witnessed by the Architect, Owner's representative, or designated Authorities.
- C. Standpipe and sprinkler system piping shall be tested to a hydrostatic test of 250 psi for two (2) hours or in accordance with other NFPA requirements as a minimum testing requirement.
- D. The Fire Protection Contractor shall, with the parties noted herein, establish procedures to witness testing that are acceptable to the parties noted herein. All parties noted herein shall be notified in writing of the accepted testing procedure prior to any testing. The Fire Protection Contractor shall notify parties designated to witness testing at least 48 hours in advance of scheduled testing.
- E. Conditions requiring testing in excess of the minimum requirements noted herein shall be performed in accordance with NFPA standards and any requirements of Authorities Having Jurisdiction.
- F. Should the Owner, Architect, Engineer or any Authority Having Jurisdiction require, the Fire Protection Contractor shall provide factory trained, manufacturer's authorized representatives to perform testing on any equipment and/or devices that may be an integral part of this specification.
- G. Dispose of test water and wastes after tests are complete, in a manner satisfactory to the Architect and Local Authorities.
- H. Furnish to the Architect/Engineer completely executed test certificates with signatures of those required to witness testing. Test certificate forms shall follow NFPA formats as a minimum requirement.
- I. The Fire Protection Contractor shall give all necessary notices, obtain and pay for all permits, pay all taxes, fees and other costs in connection with this work; file for necessary permits and approvals with the jurisdiction under which the work is to be performed. The Fire Protection Contractor shall obtain all required Certificates of Inspection for his work and deliver same to the Architect before request for acceptance of his portion of work is made and before final payment. All certificates and inspections shall be in accordance with NFPA standards as a minimum.
- J. Existing systems shall be tested to the extent of new work added shall require. All testing of existing systems shall comply with this section.
- K. All electrical alarm devices are to be tested and adjusted in conjunction with the Electrical and/or Fire Alarm Contractors. Testing or retesting and adjustment of these devices shall be at no

additional cost to the Owner. Testing and adjustment shall be as required until these devices are performing as an integral part of the total alarm system as specified for that part of the work.

4.04 CLEANING OF SYSTEMS:

- A. Before the Fire Protection Systems are accepted, all equipment shall be thoroughly cleaned to remove all dust, dirt, and/or other foreign matter which may be detrimental to the operation of the Systems or building finishes.
- B. After the installation is complete, equipment with factory finished surfaces shall be cleaned. Damaged or scratched spots shall be touched up with the same type and color paint as applied at the Factory and all cleaning and touch up shall be accomplished at no additional cost to the owner.
- C. All equipment that is to receive finish paint by the Painting Contractor shall be cleaned by The Fire Protection Contractor and left ready to have surfaces prepared to receive paint.

4.05 SYSTEM PRESSURIZATION:

- A. The Fire Protection Contractor shall pressurize systems before the Painting Contractor applies the prime coat of paint. The Fire Protection Contractor shall schedule with the Painting Contractor and Construction Manager, the timing of the work to cause sufficient time to have passed between pressurization and painting to permit cleaning of pipe joint lubricant, grease, oil, metal filings, etc., from the piping to be painted.

PART 5 - SYSTEM ACCEPTANCE

5.01 GENERAL:

- A. The installing contractor shall perform the following:
- B. Notify the Architect/Engineer, the authority having jurisdiction and Owner's representative of the time and date testing will be performed.
- C. Perform all required acceptance tests as listed herein and as required by NFPA-13.
- D. Complete and sign the appropriate contractor's material and test certificate(s) per the requirements of NFPA-13 (copies attached herewith).

5.02 ACCEPTANCE REQUIREMENTS:

- A. Hydrostatic tests: (Based upon NFPA-13, Chapter 25)
- B. All piping and attached appurtenances subjected to system working pressure shall be hydrostatically tested at 200 psi (13.8 bar) and shall maintain that pressure without loss for 2 hours.
- C. Portions of systems normally subjected to system working pressures in excess of 150 psi (10.4 bar) shall be tested at a pressure of 50 psi (3.5 bar) in excess of system working pressure.

- D. Where cold weather will not permit testing with water, an interim air test shall be permitted to be conducted.
- E. Modifications affecting 20 or fewer sprinklers shall not require testing in excess of system working pressure.
- F. Where cold weather will not permit testing with water, an interim air test shall be permitted to be conducted.
- G. Modifications affecting 20 or fewer sprinklers shall not require testing in excess of system working pressure.
- H. Where addition or modification is made to an existing system affecting more than 20 sprinklers, the new portion shall be isolated and tested at not less than 200 psi (13.8 bar) for 2 hours.
- I. Modifications that cannot be isolated, such as relocated drops, shall not require testing in excess of system working pressure.
- J. Loss shall be determined by a drop n gauge pressure or visual leakage.
- K. The test pressure shall be read from a gauge located at the low elevation point of the system or portion being tested.
- L. Additives, corrosive chemicals such as sodium silicate, or derivatives of sodium silicate, brine, or other chemicals shall not be used while hydrostatically testing systems or for stopping leaks.
- M. Piping between the exterior fire department connection and the check valve in the fire department inlet pipe shall be hydrostatically tested in the same manner as the balance of the system.
- N. When deluge systems are being hydrostatically tested, plugs shall be installed in fittings and replaced with open sprinklers after the test is completed, or the operating elements of automatic sprinklers shall be removed after the test is completed.
- O. Trenches shall be backfilled between joints before testing to prevent movement of underground piping.
- P. Where required for safety measures presented by the hazards of open trenches, the pipe and joints shall be permitted to b back filled provided the installing contractor takes the responsibility for locating and correcting leakage in excess of that permitted by NFPA-13.
- Q. Provision shall be made for the proper disposal of water used for flushing or testing.

5.03 TEST BLANKS:

- A. Test blanks shall have painted lugs protruding in such a way as to clearly indicate their presence.
- B. The test blanks shall be numbered, and the installing contractor shall have a record-keeping method ensuring their removal after work is completed.
- C. When subject to hydrostatic test pressures, the clapper of a differential-type valve shall be held off its seat to prevent damaging the valve.

5.04 WATERFLOW DEVICES:

- A. Waterflow detecting devices including the associated alarm circuits shall be flow tested through the inspector's test connection and shall result in an audible alarm on the premises within 5 minutes after such flow begins and until such flow stops.

5.05 MAIN DRAIN:

- A. The main drain valve shall be opened and remain open until the system pressure stabilizes.
- B. The static and residual pressures shall be recorded on the contractor's test certificate.

5.06 OPERATING TEST:

- A. Each hydrant shall be fully opened and closed under system water pressure, and dry barrel hydrants shall be checked for proper drainage.
- B. Where fire pumps are available, this check shall be done with the pumps running.
- C. All control valves shall be fully closed and opened under system water pressure to ensure proper operation.

5.07 BACKFLOW PREVENTION ASSEMBLIES:

- A. The back flow prevention assembly shall be forward flow tested to ensure proper operation.
- B. The minimum flow rate shall be the system demand, including hose stream demand where applicable.

5.08 INSTRUCTIONS:

- A. The installing contractor shall provide the owner with the following:
- B. All literature and instructions provided by the manufacturer describing proper operation and maintenance of any equipment and devices installed
- C. NFPA-25, Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection System

5.09 EQUIPMENT IDENTIFICATION and HYDRAULIC DESIGN INFORMATION SIGNS:

- A. Provide signs and nameplates in accordance with NFPA standards, applicable codes and/or these specifications. In particular, signs shall be provided at all drains, test and alarm valves and other areas as required by NFPA Standards and applicable codes.
- B. The installing contractor shall identify a hydraulically designed sprinkler system with a permanently marked weatherproof metal or rigid plastic sign secured with corrosion-resistant wire, chain, or other approved means. Such signs shall be placed at the alarm valve, dry pipe valve, preaction valve, or deluge valve supplying the corresponding hydraulically designed area.

C. The sign shall include the following information:

- Location of the design area or areas
- Discharge densities over the design area or areas
- Required flow and residual pressure demand at the base of the riser
- Occupancy classification or commodity classification and maximum permitted storage height and configuration
- Hose stream demand included in addition to the sprinkler demand

5.10 CONTRACTOR'S MATERIAL AND TEST CERTIFICATE FOR ABOVEGROUND PIPING:

- A. All information included within the standard Contractor's Material and Test Certificates shall be completed by the contractor and submitted for record at the completion of the project.
- B. Contractor's Material and Test Certificates shall be as noted in NFPA-13.

5.11 INSPECTION SERVICE:

- A. After completion of the fire protection work and at start of the guarantee year, the Fire Protection Contractor shall execute the National Automatic Sprinkler and Fire Control Association, Inc. Standard Form of Inspection Agreement without charge to the Owner, calling for 4 inspections of the system during the guarantee year. During the year, inspections shall be made as per the Inspection Agreement plus the following maintenance shall be performed on the last inspection:

- Operation of all control valves
- Lubrication of stems of all control valves
- Operation of all alarms
- Cleaning of all types of alarm valves and parts
- Inspection and testing of backflow prevention devices

- B. The standard form, "Report of Inspection" shall be filled out in triplicate after each inspection and copies sent to the Owner and the Owner's insuring agency.
- C. All inspections, testing and maintenance shall be in accordance with applicable NFPA Standards, including NFPA #25, as a minimum. Requirements of Owner's Insurance Company and other Authorities Having Jurisdictions are also a part of this service.

END OF SECTION 23 30 00

SECTION 23 32 00
FIRE PROTECTION: SEISMIC RESTRAINT SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 01 and the following listed sections as a minimum, apply fully to work in this section.

Section 23 00 00 MECHANICAL: GENERAL REQUIREMENTS

- B. Refer to and coordinate all work with the work of the following listed sections:

Section 23 00 50 MECHANICAL: ELECTRICAL COMPONENTS

Section 23 30 00 FIRE PROTECTION

1.02 SCOPE:

- A. Provide labor, equipment and materials to design and complete the fire protection work indicated on drawings and herein specified.
- B. It is the intent of the seismic portion of this specification to keep all fire protection system components in place during a seismic event.
- C. All such systems must be installed in strict accordance with seismic codes, component manufacturer's and building construction standards. Whenever a conflict occurs between the manufacturer's standards or construction standards, the most stringent shall apply.
- D. This specification is considered to be minimum requirements for seismic consideration and is not intended as a substitute for legislated, more stringent, national, state or local construction requirements
- E. Any variance or non-compliance with these specification requirements shall be corrected by the contractor in an approved manner.
- F. The work in this section includes, but is not limited to the following:

Equipment isolation bases.
Flexible piping connections.
Seismic restraints for isolated equipment.
Seismic restraints for non-isolated equipment.
Certification of seismic restraint designs and installation supervision.
Certification of seismic attachment of housekeeping pads.

All Fire Protection systems. Equipment buried underground is excluded but entry of services through the foundation wall is included. Equipment includes, but is not limited to, the following:

Conduit
Piping

1.03 RELATED WORK:

- A. Work in conjunction with this section shall be as designated below:

General Contractor: Cutting, Patching and Painting
Flashing, counterflashing
Access panels / doors in walls, ceilings

1.04 PROJECT ADMINISTRATION:

- A. Transmit questions, submissions, notices, and correspondence through the general contractor for transmittal to the Architect.
- B. Prepare and transmit to the Architect all submittal requirements within the time period allowed. See Schedule of Submissions.

1.05 INSPECTION AND TESTING:

- A. Inspections, examinations and tests required by authorities/agencies shall be coordinated and paid for as necessary by the Contractor to obtain complete and final acceptance of the systems. Transmit certificates of inspection, acceptance to the Architect.
- B. Review and provide closeout requirements of this section and Section 23 00 00 Mechanical General Requirements, including:

Testing and Adjusting
Record Drawings
Written Guarantee
Letters of compliance.

1.06 DEFINITIONS:

- A. Life Safety Systems:

All systems involved with fire protection including sprinkler piping, fire pumps, jockey pumps, fire pump control panels, service water supply piping, water tanks, fire dampers and smoke exhaust systems.

All systems involved with and/or connected to emergency power supply including all generators, transfer switches, transformers and all flowpaths to fire protection and/or emergency lighting systems.

All medical and life support systems.

Fresh air relief systems on emergency control sequence including air handlers, conduit, duct, dampers, etc.

B. Positive Attachment:

A positive attachment is defined as a cast-in anchor, a drill-in wedge anchor, a double sided beam clamp loaded perpendicular to a beam, or a welded or bolted connection to structure. Single sided "C" type beam clamps for support rods of overhead piping, ductwork, fire protection, electrical conduit, bus duct, or cable trays, or any other equipment are not acceptable on this project as seismic anchor points.

Restraint(s) applied to limit motion perpendicular to the centerline of the pipe, duct or conduit.

C. Transverse Bracing:

Restraint(s) applied to limit motion perpendicular to the centerline of the pipe, duct or conduit.

D. Longitudinal Bracing:

Restraint(s) applied to limit motion parallel to the centerline of the pipe, duct or conduit.

1.07 SUBMITTALS:

- A. See SUBMITTAL GENERAL REQUIREMENTS within Section 23 00 00.
- B. The following shop drawings shall be prepared and submitted for approval within the time period stated (see SCHEDULE OF SUBMISSIONS in Section 23 00 00): (The list below is not intended to be all inclusive. Provide submittals for all materials and equipment proposed for use on this project.)

Fire Protection System Piping Restraints
Fire Protection System Equipment Restraints

Seismic Certification and Analysis Reports for All Systems

1.08 SUBMITTAL DATA REQUIREMENTS:

- A. The manufacturer of vibration isolation and seismic restraints shall provide submittals for products as follows:
- B. Descriptive Data:
 - Catalog cuts or data sheets on vibration isolators and specific restraints detailing compliance with the specification.
 - Detailed schedules of flexible and rigidly mounted equipment, showing vibration isolators and seismic restraints by referencing numbered descriptive drawings.
- C. Shop Drawings:
 - Submit fabrication details for equipment bases including dimensions, structural member sizes and support point locations.

Provide all details of suspension and support for ceiling hung equipment.

Where walls, floors, slabs or supplementary steel work are used for seismic restraint locations, details of acceptable attachment methods for ducts, conduit and pipe must be included and approved before the condition is accepted for installation. Restraint manufacturers' submittals must include spacing, static loads and seismic loads at all attachment and support points.

Provide specific details of seismic restraints and anchors; include number, size and locations for each piece of equipment.

D. Seismic Certification and Analysis:

Seismic restraint calculations must be provided for all connections of equipment to the structure. Calculations must be stamped by a registered professional engineer with at least five years of seismic design experience, licensed in the state of the job location.

All restraining devices shall have a preapproval number from California OSHPD or some other recognized government agency showing maximum restraint ratings. Preapprovals based on independent testing are preferred to preapprovals based on calculations. Where preapproved devices are not available, submittals based on independent testing are preferred. Calculations (including the combining of tensile and shear loading) to support seismic restraint designs must be stamped by a registered professional engineer with at least five years of seismic design experience and licensed in the state of the job location. Testing and calculations must include both shear and tensile loads as well as one test or analysis at 45° to the weakest mode.

Analysis must indicate calculated dead loads, static seismic loads and capacity of materials utilized for connections to equipment and structure. Analysis must detail anchoring methods, bolt diameter, embedment and/or welded length. All seismic restraint devices shall be designed to accept, without failure, the forces detailed in section 1 .06 acting through the equipment center of gravity. Overturning moments may exceed forces at ground level.

1.09 CODE AND STANDARDS REQUIREMENTS:

- A. Applicable codes and Standards: (Note, all restraint systems shall conform to Seismic Zone 2 requirements)

Rhode Island State Building Code

International Mechanical Code, 2015 Edition

NFPA-13, 2010 Edition

1.10 MANUFACTURER'S RESPONSIBILITY:

- A. Manufacturer of vibration isolation and seismic control equipment shall have the following responsibilities:
- B. Determine vibration isolation and seismic restraint sizes and locations.

- C. Provide vibration isolation and seismic restraints as scheduled or specified.
- D. Provide calculations and materials if required for restraint of unisolated equipment.
- E. Provide installation instructions, drawings and trained field supervision to insure proper installation and performance.

1.11 RELATED WORK:

A. Supplementary Support Steel:

Contractor shall supply supplementary support steel for all equipment, piping, ductwork, etc. including roof mounted equipment, as required or specified.

B. Attachments:

Contractor shall supply restraint attachment plates cast into housekeeping pads, concrete inserts, double-sided beam clamps, etc. in accordance with the requirements of the vibration vendor's calculations.

1.12 SEISMIC FORCE LEVELS:

A. The following force levels shall be used on this project.

Seismic Zone: 2a

"G" Force Level Required:

Piping and Conduit	0.25 horizontal	0.08 vertical
Rigidly Mounted Equipment	0.40 horizontal	0.15 vertical
Flexibly Mounted Equipment	0.40 horizontal	0.15 vertical
All Life Safety Equipment	0.60 horizontal	0.20 vertical

PART 2 - SEISMIC RESTRAINTS

2.01 INTENT:

- A. All seismic restraints described in this section shall be the product of a single manufacturer. Mason Industry's products are the basis of these specifications; products of other manufacturers are acceptable provided their systems strictly comply with the specification and have the approval of the specifying engineer. Submittals and certification sheets shall conform to the standards as defined herein.
- B. For the purposes of this project, failure is defined as the discontinuance of any attachment point between equipment or structure, vertical permanent deformation greater than 1/8 inch and/or horizontal permanent deformation greater than 1/4 inch.

2.02 GENERAL:

- A. All seismic restraint systems must be installed in strict accordance with the manufacturers written instructions and all certified submittal data.
- B. Installation of seismic restraints must not cause any change of position of equipment or piping resulting in stresses or misalignment.
- C. No rigid connections between equipment and the building structure shall be made that degrades the noise and vibration control system herein specified.
- D. The contractor shall not install any equipment, piping or conduit that makes rigid connections with the building unless isolation is not specified. "Building" includes, but is not limited to, slabs, beams, columns, studs and walls.
- E. Coordinate work with other trades to avoid rigid contact with the building.
- F. Any conflicts with other trades which will result in rigid contact with equipment or piping due to inadequate space or other unforeseen conditions should be brought to the architects/engineers attention prior to installation. Corrective work necessitated by conflicts after installation shall be at the responsible contractor's expense.
- G. Bring to the architects/engineers attention any discrepancies between the specifications and the field conditions or changes required due to specific equipment selection, prior to installation. Corrective work necessitated by discrepancies after installation shall be at the responsible contractor's expense.
- H. Correct, at no additional cost, all installations that are deemed defective in workmanship and materials at the contractor's expense.
- I. Overstressing of the building structure must not occur because of overhead support of equipment. Contractor must submit loads to the structural engineer of record for approval. Generally bracing may occur from:
 - Flanges of structural beams.
 - Upper truss cords in bar joist construction.
 - Cast in place inserts or wedge type drill-in concrete anchors.
- J. Cable restraints shall be installed slightly slack to avoid short circuiting the isolated suspended equipment, piping or conduit.
- K. Cable assemblies are installed taut on non-isolated systems. Seismic solid braces may be used in place of cables on rigidly attached systems only.
- L. At locations where cable assembly or solid restraints are located, the support rods must be braced when necessary to accept compressive loads through the use of seismic rod braces and clamps.
- M. At all locations where cable or solid restraints are attached to pipe clevises, the clevis cross bolt must be reinforced with seismic cross braces.

- N. Drill-in concrete anchors for ceiling and wall installation shall be the seismic type and shall conform to IBCO No. 1821. Drill-in concrete anchors for floor mounted equipment shall be the female wedge type conforming to IBCO No. 5063.
- O. Vibration isolation manufacturer shall furnish integral structural steel bases as required. Independent steel rails are not permitted on this project.
- P. Hand built elastomeric expansion joints may be used when pipe sizes exceed 24" or specified movements exceed the capabilities of type SFDEJ manufactured expansion joints.
- Q. Where piping passes through walls, floors or ceilings the vibration isolation manufacturer shall provide a minimum of ¾" neoprene closed cell sponge seal within the specified wall sleeve.

Refer to Section 23 00 00 - MECHANICAL GENERAL REQUIREMENTS for pipe sleeve requirements.

- R. Locate isolation hangers as near to the overhead support structure as possible.

2.03 SEISMIC RESTRAINT OF PIPING:

- A. Scope: All piping, listed as follows shall be seismically restrained:
- B. All fire protection main piping that is 1" I.D. or larger which is clevis or trapeze supported where the hanger rod length from the point of attachment to the building structure to the structural attachment of the clevis or trapeze exceeds 6".
- C. For piping systems seismic restraints may be type SSB solid braces.
- D. Transverse piping restraints shall be at 40' maximum spacing for all pipe sizes, except where lesser spacing is required to limit anchorage loads.
- E. Longitudinal restraints shall be at 80' maximum spacing for all pipe sizes, except where lesser spacing is required to limit anchorage loads.
- F. Transverse restraint for one pipe section may also act as a longitudinal restraint for a pipe section of the same size connected perpendicular to it if the restraint is installed within 24" of the elbow or TEE or combined stresses are within allowable limits at longer distances.
- G. Hold down clamps must be used to attach pipe to all trapeze members before applying restraints in a manner similar to clevis supports.
- H. Branch lines may not be used to restrain main lines.

2.04 SEISMIC RESTRAINT OF FIRE PROTECTION EQUIPMENT:

- A. Scope: All fire protection equipment, listed as follows shall be seismically restrained:

All floor mounted fire pumps and fire pump control cabinets.

All suspended Pumps weighing more than 50 lbs. which are not rigidly connected to the supply side of the duct system or supported with a minimum of 4 hanger rods.

- B. For fire protection systems that are not provided with vibration isolation hangers, seismic restraints may be type SSB solid braces.
- C. Secure all floor type isolators rigidly to the floor structure with approved type seismic connections or to concrete floor decks with type SAS seismic anchor studs or type SAB seismic anchor bolts.
- D. Base mounted equipment, such as end suction pumps, installed on inertia bases shall have the bases seismically restrained with type Z1225 all directional seismic snubbers complete with base anchor bolts, all directional bridge bearing type neoprene bushing and snubber bolt and washer. The snubber assembly shall be secured rigidly to the floor structure with approved type seismic connections or to concrete floor decks with type SAS seismic anchor studs or type SAB seismic anchor bolts.
- E. All floor mounted controller cabinets shall be restrained against lateral movement through the installation of restraining angles at the unit perimeters or corners. The restraining angles shall be secured rigidly to the floor structure with approved type seismic connections or to concrete floor decks with type SAS seismic anchor studs or type SAB seismic anchor bolts.
- F. Any floor mounted equipment subject to overturning in the event of a seismic occurrence shall be restrained through the use of cabling or strapping. The cable or strapping shall be secured rigidly to the adjacent wall structure with approved type seismic connections or to concrete floor decks with type SAS seismic anchor studs or type SAB seismic anchor bolts.

2.05 SEISMIC RESTRAINT OF CONTROL SYSTEM DEVICES:

- A. Scope: All electrical and control system devices, listed as follows shall be seismically restrained:
- B. All electrical conduit 2 1/2" in diameter and larger which are supported by hanger rods where the hanger rod length from the point of attachment to the building structure to the structural attachment to the conduit exceeds 12".
- C. For electrical and control system devices, seismic restraints shall be type SCB, SCBH or SCBV cables, or type SSB solid braces.
- D. Transverse restraints shall occur at 30' intervals or both ends if the electrical run is less than the specified interval. Transverse restraints shall be installed at each electrical services turn and at each end of the electric run.
- E. Longitudinal restraints shall occur at 60' intervals with at least one restraint per electric run. Transverse restraints for one electric section may also act as a longitudinal restraint for an electric section connected perpendicular to it if the restraints are installed within 4' of the intersection of the electric run and if the restraints are sized for the larger electric run.
- F. All rigid floor mounted equipment must have a resilient media between the equipment mounting hole and the anchor bolt. Anchor bolts shall be designed in accordance with the specified seismic force levels. Neoprene bushings shall be type HG and anchor bolts shall be type SAS conforming to ICBO No. 1821 or type SAB conforming to ICBO No. 5063.
- G. Wall mounted panels shall be mounted with type PB inner and outer bushings secured to the structure with type SAS anchor studs. Floor mounted panels shall be mounted on type HG neoprene bushings secured to the floor with type SAS or type SAB anchor studs.

END OF SECTION 23 32 00

**SECTION 23 55 00
HVAC: HYDRONIC SYSTEMS**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 01 and the following listed sections as a minimum, apply fully to work in this section.

Section 23 00 00 MECHANICAL GENERAL REQUIREMENTS

- B. Refer to and coordinate all work with the work of the following listed Sections:

Section 23 00 50 MECHANICAL: ELECTRICAL COMPONENTS

Section 23 01 50 MECHANICAL: VIBRATION ISOLATION

Section 23 02 50 MECHANICAL: PIPE HANGERS AND SUPPORTS

Section 23 03 00 MECHANICAL: FIRE SAFING / FIRESTOPPING

Section 23 04 00 MECHANICAL: INSULATION

Section 23 04 40 MECHANICAL: PIPE CLEANING TESTING

Section 23 85 00 HVAC: EQUIPMENT

1.02 SCOPE:

- A. Provide labor, equipment and materials to complete the work indicated on drawings and herein specified.

1.03 RELATED WORK:

- A. Work in conjunction with this section shall be as designated below:

General Contractor:

Cutting, Patching, and Painting
Openings in roofs / Flashing
Openings in walls
Equipment foundations and bases
All temporary heating

Electrical Contractor:

Power wiring for electrical equipment provided within this section.

1.04 PROJECT ADMINISTRATION:

- A. Transmit questions, submissions, notices, and correspondence through the general contractor for transmittal to the Architect.
- B. Prepare and transmit to the Architect all submittal requirements within the time period allowed. See Schedule of Submissions.

1.05 SUBMITTALS:

- A. See SUBMITTAL GENERAL REQUIREMENTS within Section 23 00 00.
- B. The following shop drawings shall be prepared and submitted for approval within the time period stated (see SCHEDULE OF SUBMISSION in Section 23 00 00): (The list below is not intended to be all-inclusive. Provide submittals for all materials and equipment proposed for use on this project)

- Pipe and fittings
- Valves, cocks, unions
- Piping specialties
- Pipe hangers, supports

1.06 PROJECT CLOSE-OUT:

- A. Review and provide close-out requirements of this section and Section 23 00 00 Mechanical General Requirements, including:

- Testing and Adjusting
- Record Drawings
- Operating, Maintenance Instructions
- Written Guarantee
- Lubrication, Filters
- Operating, Maintenance Manuals
- Cleaning
- Test Log
- Letters of compliance

PART 2 - PIPING PRODUCTS AND INSTALLATION

2.01 PIPING: INSTALLATION, GENERAL:

- A. Arrange and install piping approximately as indicated and as straight, plumb, and direct as possible. Form right angles or parallel lines with building wall. Keep pipe close to walls, partitions and ceilings. Offset only where necessary to follow walls. Where so indicated and wherever possible, conceal piping in building construction before erection of closing construction. When furred spaces are indicated, keep pipes as close to structural members as possible. Piping shall not interfere with openings, doors and windows. Allow for proper clearance at windows, doors, equipment and other building parts such that piping does not interfere with access and building use.

- B. Piping shall be cut accurately to measurements established at the site and shall be installed without springing, forcing and excessive cutting or weakening of building structure. Pipes shall be installed in a manner permitting proper drainage, venting and free expansion and contraction. Changes in direction shall be made with factory-manufactured fittings.
- C. Install pipe to allow for expansion without excessive stress on pipe, hangers and building.
- D. Welding, brazing, soldering shall be with proper regard for fire prevention and safety.
- E. Arrange piping passing through floors, walls and other partitions of building construction so that piping is centered in openings / sleeves and is rigidly supported on both sides of openings / sleeves.
- F. Clean pipe, pipe fittings, and valves before erection. Cap or plug open ends of piping and equipment during construction to keep dirt and foreign material out of system.
- G. Before installing, clean black steel pipe and fittings by hammering to loosen scale and rust and flush out with water or blow out with compressed air or high pressure steam under controlled safe conditions.
- H. After threading steel pipe, clean pipe ends carefully to remove cutting oil and metal particles.
- I. Unions or flanges shall be used to facilitate piping installation, and shall be installed between shut-off valves and equipment to facilitate removal of equipment for repair.
- J. Provide dielectric unions where pipes of dissimilar metals are joined together.
- K. Grade gravity waste from cooling coil drain pans at uniform slope of 1/4" per foot.
- L. Copper tube, of annealed or bending temper quality, where indicated to be installed without joints or fittings, shall be bent to accomplish changes of direction. Bending shall not collapse outside nor buckle inside of bend. Proper radius, method and tools required shall comply with Copper Tube Handbook.
- M. Branch piping connections from mains to fixed equipment and connections from risers to horizontal mains shall have minimum of three (3) 90 degree elbows and be arranged in swing fashion to permit unrestricted expansion and contraction of piping and minimize stress at connections to risers and fixed equipment.
- N. Do not route pipelines over switchboards, panels, motor control centers, individual motor starters and other electrical equipment.
- O. Avoid routing pipelines over electrical raceways and bus ducts. If these locations cannot be avoided, provide drip pans under pipelines. Also provide drip pans where indicated on the Drawings. Drip pans shall be constructed of minimum 22 gauge stainless sheet metal with waterproof mastic applied to interior seams and joints. Pan width shall be minimum 2 times pipe diameter and with sides turned up minimum of 4" high and fitted with hemmed edge. Do not hang drip pans from pipe. Pitch pans minimum 1/8" per foot and provide 3/4" drain connection at low points. Pipe drains to nearest floor drain or as shown on the Drawings.
- P. Provide pipe vents and pressure relief from equipment and piping systems in accordance with applicable codes. Unless otherwise specified, vent and relief piping shall match system to which attached.

2.02 CROSS AND INTER-CONNECTIONS:

- A. No piping for equipment, device or any apparatus internal connection shall be installed which will provide a cross or interconnection, under any circumstance of operation, between a distributing supply for drinking or domestic purposes and a not-potable supply or a drainage system or a soil or sanitary waste pipe which will permit or make possible the back-flow of sewage, polluted water or waste into the domestic water supply system.

2.03 PIPING: CONDENSATE DRAIN (PEX tubing, plenum rated)

PIPE CLASS:	P1
PIPE SYMBOL	D
CLEANING CLASS	C1
TESTING CLASS	T4

- A. Manufacturers:

Acceptable Manufacturer: Uponor, which is located at: 5925 148th St. W.; Apple Valley, MN 55124

- B. PEX Pipe and Fittings:

PEX-a (Engel-Method Crosslinked Polyethylene) Piping: ASTM F 876 and F877 (CAN/CSA-B137.5) by Uponor.

PEX-a Fittings: elbows, adapters, couplings, plugs, tees and multi-port tees (1/2 inch through 3 inch nominal pipe size): ASTM F1960 cold-expansion fitting manufactured from the following material types:

UNS No. C69300 Lead-free (LF) Brass.

UNS No. C27453 Lead-free (LF) Brass.

20% glass-filled polysulfone as specified in ASTM D 6394.

Unreinforced polysulfone (group 01, class 1, grade 2) as specified in ASTM D 6394.

Polyphenylsulfone (group 03, class 1, grade 2) as specified in ASTM D 6394.

Blend of polyphenylsulfone (55-80%) and unreinforced polysulfone (rem.) as specified in ASTM D 6394.

Reinforcing cold-expansion rings shall be manufactured from the same source as PEX-a piping manufacturer and marked "F1960".

Pre-Sleeved Piping (1/2 inch (16mm) through 3/4 inch (20mm) nominal pipe size): PEX-a piping, with a high-density polyethylene (HDPE) corrugated sleeve.

Pre-Insulated Piping (1/2 inch (16mm) through 2 inch (50mm) nominal pipe size): PEX-a piping, with a closed-cell polyethylene foam insulation.

Multi-Port Tees: Multiple-outlet fitting complying with ASTM F 877 (CAN/CSA B137.5); with ASTM F 1960 inlets and outlets.

Engineered polymer branch multi-port tee.

Engineered polymer flow-through multi-port tee.

Engineered polymer commercial branch multi-port tee.

Engineered polymer commercial branch multi-port elbow.

Engineered polymer commercial flow-through multi-port tee.

Manifolds: Multiple-outlet assembly complying with ASTM F 877 (CAN/CSA B137.5); with ASTM F 1960 outlets.

Engineered polymer valved manifold.
Engineered polymer valveless manifold.
Lead - free copper branch manifold.
Lead-free copper valved manifold.

C. Transition Fittings:

PEX-to-Metal Transition Fittings:

Manufacturers: Provide fittings from the same manufacturer of the piping.
PEX-a to Threaded Brass Transition: One-piece brass fitting with male or female threaded adapter and ASTM F 1960 cold-expansion end, with PEX-a reinforcing cold-expansion ring.

PEX-a to Brass Sweat Transition: One-piece brass fitting with sweat adapter and ASTM F 1960 cold-expansion end, with PEX-a reinforcing cold-expansion ring.

PEX-a to Flange Transition: Two-piece fitting with one steel flange conforming to ASME B 16.5 and one lead free (LF) brass adapter conforming to ASTM F 1960.

PEX-a to Groove Transition: One-piece lead free (LF) brass fitting with one CSA B242-05 groove end in either iron pipe size (IPS) or copper tube size (CTS) and one ASTM F1960 cold-expansion end, with PEX-a reinforcing cold-expansion ring.

PEX-a to Water Meter Transition: Two-piece fitting with one NPSM union thread and one ASTM F 1960 cold-expansion end, with PEX-a reinforcing cold-expansion ring.

PEX-a to Copper Press Transition: One-piece lead free (LF) brass fitting with one ASME B16.51 copper press end and one ASTM F1960 cold-expansion end, with PEX-a reinforcing cold-expansion ring.

PEX-to-Thermoplastic Transition Fittings:

PEX-a to CPVC Transition: Thermoplastic fitting with one spigot or socket end and one ASTM F 1960 cold-expansion end, with PEX-a reinforcing cold-expansion ring.

D. Installation:

Install plumbing system according to approved shop drawings and coordination drawings.

Comply with manufacturer's product data, including product technical bulletins, installation instructions and design drawings, including the following.

E. Piping Installation:

Install PEX-a Pipe Support, fixed anchor points and hangers in compliance with the Uponor Commercial Piping Pocket Guide (2017).

PEX shall not be installed in areas within five feet of UV light unless protected.

Install piping in compliance with manufacturer's Commercial Piping Pocket Guide (2017).

F. Hangers and Supports:

Horizontal PEX-a Piping Hangers: Install CTS hangers suitable for PEX-a piping in compliance with the Uponor Commercial Piping Pocket Guide (2017) and local codes, with the following maximum spacing:

For IPC Jurisdictions: 3 inch (75mm) and below: Maximum span, 32 inches (0.81 m).

Note: The above maximum hanger spacing requirements may be extended with the use of a continuous support channel such as Uponor PEX-a Pipe Support.

Horizontal PEX-a Piping with PEX-a Pipe Channel: Install hangers for PEX-a piping with horizontal support channel in accordance with local jurisdiction and manufacturer's recommendations, with the following maximum spacing:

3/4 inch (20 mm) and below: Maximum span, 6 feet (1.8 m).

1 inch (25 mm) and above: Maximum span, 8 feet (2.4 m).

Vertical PEX-a Piping: Support PEX-a piping with maximum spacing of 5 feet (1.5 m).

PEX-a Riser Supports: Install CTS riser clamps at the base of each floor and at the top of every other floor for domestic hot-water systems. Install mid-story guides between each floor. Install CTS riser clamps at the base of each floor and at the top of every fourth floor for domestic cold-water systems. Install mid-story guides.

G. Pipe Joint Construction: PEX-a Connections: Install per manufacturer's recommendations. Use manufacturer-recommended cold-expansion tool for ASTM F 1960 connections.

H. Field Quality Control: Do not expose PEX piping to direct sunlight for more than 30 days. If construction delays are encountered, provide cover to portions of piping exposed to direct sunlight.

2.04 PIPING: CONDENSATE DRAIN (PVC)

PIPE CLASS:	P1
PIPE SYMBOL	D
CLEANING CLASS	C1
TESTING CLASS	T4

A. Material: Provide PVC type schedule 40 drainage pipe and fittings, as manufactured by ITT Grinnell, Yardley, Celanese, or approved equal.

B. Joints: Solvent fused socket type with chemical designed for this use.

C. Cleanouts: Provide "tee" cleanouts at changes of flow direction.

D. Supports: Place hangers, supports at intervals not exceeding manufacturers' recommended intervals. See PIPE SUPPORTS.

PART 3 - PIPING APPURTENANCES AND INSTALLATION

3.01 UNIONS:

- A. Provide unions at equipment connections, as indicated, and as required to make future repairs. Unions 2" and smaller: Stockham, Grinnell; unions larger shall be flanged.

3.02 DIELECTRIC UNIONS, FLANGES, HANGERS:

- A. Where dissimilar metals connect, provide dielectric unions, dielectric flanges or hangers to prevent electrolysis.

3.03 SLEEVES: PIPE

- A. Walls: Where piping penetrates masonry or concrete walls, provide sch 40 steel pipe sleeve flush with wall, of size to allow passage of pipe insulation.
- B. Floor: Where piping penetrates floor, provide sch 40 steel pipe sleeve extending 1/2" above finished floor, of size to allow passage of pipe insulation.
- C. Fire Stop: Pack sleeve openings full depth with glass wool to seal opening.

3.04 SUPPORTS: PIPE HANGERS:

- A. General: Provide pipe supports, hangers, or other appurtenance to firmly support the piping systems. All pipes shall be independently supported from the building structure and not from other pipes, flues, conduits, ducts or pipe hangers, etc.
- B. Refer to Section 230250 – MECHANICAL PIPE HANGERS AND SUPPORTS for pipe hanging requirements.

3.05 AIR VENTS:

- A. Provide air vents with shut-off cocks at all high points and where air entrapment may occur. Install piping system such that high points and pockets occur only when unavoidable.
- B. Automatic Air Vents: Float type Model #423 with overflow connection and cock.
- C. Manual Air Vents: Provide manual air vent cocks at points to allow for rapid fill and draining of system at high points and at top of risers.

PART 4 – INSULATION:

4.01 INSULATION: GENERAL:

- A. Provide all insulation as specified in a neat and workmanlike manner observing the best practices of the trade. All longitudinal seams shall be flat and facing away from view. Insulation shall be smooth throughout. Vapor barriers, where required, shall be continuous. No raw ends of material shall be permitted; cover raw ends with eight-ounce canvas or approved equal.
- B. Piping and equipment shall be insulated as specified within Section 230400 – MECHANICAL INSULATION.

END OF SECTION 23 55 00

SECTION 23 56 50
HVAC: REFRIGERANT SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 01 and the following listed sections as a minimum, apply fully to work in this section.

Section 23 00 00 MECHANICAL GENERAL REQUIREMENTS

- B. Refer to and coordinate all work with the work of the following listed Sections:

Section 23 00 50 MECHANICAL: ELECTRICAL COMPONENTS

Section 23 01 50 MECHANICAL: VIBRATION ISOLATION

Section 23 02 50 MECHANICAL: PIPE HANGERS AND SUPPORTS

Section 23 03 00 MECHANICAL: FIRE SAFING / FIRESTOPPING

Section 23 04 00 MECHANICAL: INSULATION

Section 23 04 40 MECHANICAL: PIPE CLEANING TESTING

Section 23 56 50 HVAC: REFRIGERANT SYSTEMS

Section 23 85 00 HVAC: EQUIPMENT

1.02 SCOPE:

- A. Provide labor, equipment and materials to complete the work indicated on drawings and herein specified, to include:

Field refrigerant piping for direct expansion HVAC systems.

Field refrigerant piping and associated drain and condenser water piping for walk-in refrigerators and freezers, including required pipe insulation.

1.03 DEFINITIONS:

- A. Refrigerating system: Combination of interconnected refrigerant-containing parts constituting one closed refrigeration circuit in which a refrigerant is circulated for the purpose of extracting heat.
- B. Low side means the parts of a refrigerating system subjected to evaporator pressure.
- C. High side means the parts of a refrigerating system subjected to condenser pressure.
- D. Brazed joint: A gas-tight joint obtained by the joining of metal parts with alloys which melt at temperatures higher than 427 degrees C (800 degrees F) but less than the melting temperatures of the joined parts.

1.04 RELATED WORK:

- A. Work in conjunction with this section shall be as designated below:

General Contractor:

Cutting, Patching, and Painting
Openings in roofs / Flashing
Openings in walls
Equipment foundations and bases
All temporary heating

Electrical Contractor:

Power wiring for electrical equipment provided within this section.

1.05 PROJECT ADMINISTRATION:

- A. Transmit questions, submissions, notices, and correspondence through the General Contractor for transmittal to the Architect.
- B. Prepare and transmit to the Architect all submittal requirements within the time period allowed. See Schedule of Submissions.

1.06 SUBMITTALS:

- A. See SUBMITTAL GENERAL REQUIREMENTS within Section 23 00 00.
- B. The following shop drawings shall be prepared and submitted for approval within the time period stated (see SCHEDULE OF SUBMISSIONS in Section 23 00 00): (The list below is not intended to be all inclusive. Provide submittals for all materials and equipment proposed for use on this project.)

Tubing and fittings
Valves
Strainers
Moisture-liquid indicators
Filter-dryers
Oil separators (when specified)
Pipe and equipment supports
Flexible elastomeric pipe insulation
Refrigerant and oil
Pipe/conduit roof penetration cover
Soldering and brazing materials

Layout of refrigerant piping and accessories, including flow capacities, valves locations, and oil traps slopes of horizontal runs, floor/wall penetrations, and equipment connection details.

Certification: Copies of certificates for welding procedure, performance qualification record and list of welders' names and symbols.

1.07 PROJECT CLOSE-OUT:

- A. Review and provide closeout requirements of this section and Section 230000 Mechanical General Requirements, including:

- Testing and Adjusting
- Record Drawings
- Operating, Maintenance Instructions
- Written Guarantee
- Lubrication, Filters
- Operating, Maintenance Manuals
- Cleaning
- Test Log
- Letters of compliance

PART 2 - PIPING PRODUCTS AND INSTALLATION

2.01 PIPING: INSTALLATION, GENERAL:

- A. Arrange and install piping approximately as indicated, straight, plumb, and as direct as possible. Form right angles or parallel lines with building wall. Keep pipe close to walls, partitions and ceilings. Offset only where necessary to follow walls. Where so indicated and wherever possible, conceal piping in building construction before erection of closing construction. When furred spaces are indicated, keep pipes as close to structural members as possible. Piping shall not interfere with openings, doors and windows. Allow for proper clearance at windows, doors, equipment and other building parts such that pipe does not interfere with access and building use.
- B. Piping shall be cut accurately to measurements established at the site and shall be installed without springing, forcing and excessive cutting or weakening of building structure. Pipes shall be installed in a manner permitting proper drainage, venting and free expansion and contraction. Changes in direction shall be made with factory-manufactured fittings.
- C. Install pipe to allow for expansion without excessive stress on pipe, hangers and building.
- D. Welding, brazing, soldering shall be with proper regard for fire prevention and safety.
- E. Arrange piping passing through floors, walls and other partitions of building construction so that piping is centered in openings / sleeves and is rigidly supported on both sides of openings / sleeves.
- F. Clean pipe, pipe fittings, and valves before erection. Cap or plug open ends of piping and equipment during construction to keep dirt and foreign material out of system.
- G. Unions or flanges shall be used to facilitate piping installation, and shall be installed between shut-off valves and equipment to facilitate removal of equipment for repair.
- H. Provide dielectric unions where pipes of dissimilar metals are joined together.
- I. Copper tube, of annealed or bending temper quality, where indicated to be installed without joints or fittings, shall be bent to accomplish changes of direction. Bending shall not collapse outside nor buckle inside of bend. Proper radius, method and tools required shall comply with Copper Tube Handbook.

- J. Branch piping connections from mains to fixed equipment and connections from risers to horizontal mains shall have minimum of three (3) 90 degree elbows and be arranged in swing fashion to permit unrestricted expansion and contraction of piping and minimize stress at connections to risers and fixed equipment.
- K. Do not route pipelines over switchboards, panels, motor control centers, individual motor starters and other electrical equipment.
- L. Avoid routing pipelines over electrical raceways and bus ducts. If these locations cannot be avoided, provide drip pans under pipelines. Also provide drip pans where indicated on the Drawings. Drip pans shall be constructed of minimum 22 gauge stainless sheet metal with waterproof mastic applied to interior seams and joints. Pan width shall be minimum 2 times pipe diameter and with sides turned up minimum of 4" high and fitted with hemmed edge. Do not hang drip pans from pipe. Pitch pans minimum 1/8" per foot and provide 3/4" drain connection at low points. Pipe drains to nearest floor drain or as shown on the Drawings.
- M. Provide pipe vents and pressure relief from equipment and piping systems in accordance with applicable codes. Unless otherwise specified, vent and relief piping shall match system to which attached.

2.02 PIPING AND FITTINGS, GENERAL:

- A. Refrigerant Piping: Copper refrigerant tube, ASTM B280, cleaned, dehydrated and sealed, marked ACR on hard temper straight lengths. Coils shall be tagged ASTM B280 by the manufacturer.

2.03 PIPING: REFRIGERANT

- A. Material: Provide seamless, hard drawn, Copper refrigerant tube, ASTM B280, cleaned, dehydrated and sealed, marked ACR on hard temper straight lengths.
- B. All joints shall be made with wrought copper or brass fittings, designed for use with high temperature solder and suitable for working pressure of 300 psi.
- C. Coils shall be tagged ASTM B280 by the manufacturer.
- D. Joints: Silver braze joints while nitrogen gas is blown through piping.
- E. Sizing: Refrigerant pipe size shall conform to current standards of Air Conditioning and Refrigeration Machinery Association Inc and equipment manufacturer. Provide a SCHEMATIC PIPE SIZING AND APPURTENANCE DIAGRAM for approval prior to start of work.
- F. Connections to Equipment: Provide flexible braided metal pipe connectors at direct connections to compressors. Refer to equipment installation data for additional requirements.
- G. Workmanship: Provide experienced refrigeration mechanics to perform piping installation. Isolate piping for proper vibration and noise transmission control.
- H. Testing: Evacuate system to 2.5 mm of mercury absolute; introduce dry nitrogen or dry carbon dioxide necessary to pressurize system to 300 psig. Inspect all joints with halide torch. Repair all leakage. Evacuate system to 2.5 mm of mercury absolute; seal; and check pressure maintained for 24 hours.

- I. Start-Up: Install temporary dehydrator for a period of one week while under normal run conditions. Remove dehydrator and insulate piping.

2.04 FITTINGS, VALVES AND ACCESSORIES:

- A. Solder joints: Wrought copper fittings, ANSI B16.22.

Solder, refrigerant tubing: Cadmium free, AWS A5.8, 45 percent silver brazing alloy, Class BAg-5.
Solder, water and drain: 95-5 tin-antimony, ASTM B32 (95TA).
Flanges and flanged fittings: ANSI B16.24.

- B. Stop Valves: Brass or bronze alloy, packless, or packed type with gas tight cap, frost proof, backseating.
- C. Pressure Relief Valves: Forged brass with nonferrous, corrosion resistant internal working parts of high strength, cast iron bodies conforming to ASTM A126, Grade B. Set valves in accordance with ASHRAE Standard 15.
- D. Solenoid Valves: ARI 760, UL-listed, two-position, direct acting or pilot-operated, moisture and vapor-proof type of corrosion resisting materials, designed for intended service, and solder-end connections. Fitted with suitable NEMA 250 enclosure of type required by location and normally open, closed or holding coil as required.
- E. Thermostatic Expansion Valves: Brass body with stainless steel or non-corrosive non ferrous internal parts, diaphragm and spring-loaded (direct-operated) type with sensing bulb and distributor having side connection for hot-gas bypass and external equalizer. Size and operating characteristics as recommended by manufacturer of evaporator and factory set for superheat requirements. Solder-end connections. Testing and rating in accordance with ASHRAE Standard 17.
- F. Check Valves: Brass or bronze alloy with swing or lift type, with tight closing resilient seals for silent operation; designed for low pressure drop, and with solder-end connections. Direction of flow shall be legibly and permanently indicated on the valve body.
- G. Strainers: Designed to permit removing screen without removing strainer from piping system, and provided with screens 80 to 100 mesh in liquid lines up to 30 mm (1-1/8 inch), 60 mesh in liquid lines over 30 mm (1-1/8 inch), and 40 mesh in suction lines. Provide strainers in liquid line serving each thermostatic expansion valve, and in suction line serving each refrigerant compressor not equipped with integral strainer.
- H. Refrigerant Moisture/Liquid Indicators: Double-ported type having heavy sight glasses sealed into forged bronze body and incorporating means of indicating refrigerant charge and moisture indication. Provide screwed brass seal caps.
- I. Refrigerant Filter-Dryers: UL listed, angle or in-line type, as shown on drawings. Conform to ASHRAE Standard 63. Heavy gauge steel shell protected with corrosion-resistant paint; perforated baffle plates to prevent desiccant bypass. Size as recommended by manufacturer for service and capacity of system with connection not less than the line size in which installed. Filter dryers with replaceable filters shall be furnished with one spare element of each type and size.
- J. Oil Separators: Provide for condensing units, as shown. All welded steel construction with capacity to eliminate a minimum of 95 percent of the oil from the hot gas flowing through it. Provide manufacturer's published ratings for minimum and maximum refrigeration tonnage corresponding to this oil separating efficiency. Conform to ASHRAE Standard 69. Separator shall be equipped with a float valve to prevent return of the hot gas to crankcase, and shall have

isolating stop valves so it can be opened and services without pumping out any other part of the system. ASME construction or UL listed.

2.05 SUPPORTS: PIPE HANGERS:

- A. General: Provide pipe supports, hangers, or other appurtenance to firmly support the piping systems. All pipes shall be independently supported from the building structure and not from other pipes, flues, conduits, ducts or pipe hangers, etc.
- B. Refer to Section 23 02 50 – MECHANICAL PIPE HANGERS AND SUPPORTS for pipe hanging requirements.

2.06 REFRIGERANTS AND OIL:

- A. Provide required refrigerant and oil for proper system operation.
- B. All systems are to be fully charged at the completion of work, prior to system balancing and commissioning.

2.07 PIPE/CONDUIT ROOF PENETRATION COVER:

- A. Prefabricated Roof Curb: Galvanized steel or extruded aluminum 300 mm (12 inches) overall height, continuous welded corner seams, treated wood nailer, 40 mm (1-1/2 inch) thick, 48 kg (3 pound) density rigid mineral fiberboard insulation with metal liner, built-in cant strip (except for gypsum or tectum decks). For surface insulated roof deck, provide raised cant strip (recessed mounting flange) to start at the upper surface of the insulation. Curbs shall be constructed for pitched roof or ridge mounting as required to keep top of curb level.
- B. Penetration Cover: Galvanized sheet metal with flanged removable top. Provide 40 mm (1-1/2 inch) thick mineral fiber board insulation.
- C. Flashing Sleeves: Provide sheet metal sleeves for conduit and pipe penetrations of the penetration cover. Seal watertight penetrations.

2.08 PIPE INSULATION FOR DX HVAC SYSTEMS

- A. Provide all insulation as specified in a neat and workmanlike manner observing the best practices of the trade. All longitudinal seams shall be flat and facing away from view. Insulation shall be smooth throughout. Vapor barriers, where required, shall be continuous. No raw ends of material shall be permitted; cover raw ends with eight-ounce canvas or approved equal.
- B. Piping and equipment shall be insulated as specified within Section 23 04 00 – MECHANICAL INSULATION.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Install piping as short as possible, with a minimum number of joints, elbows and fittings.

- B. Install piping with adequate clearance between pipe and adjacent walls and hangers to allow for service and inspection. Space piping, including insulation, to provide 25 mm (one inch) minimum clearance between adjacent piping or other surface. Use pipe sleeves through walls, floors, and ceilings, sized to permit installation of pipes with full thickness insulation.
- C. Locate and orient valves to permit proper operation and access for maintenance of packing, seat and disc. Generally locate valve stems in overhead piping in horizontal position. Provide a union adjacent to one end of all threaded end valves. Control valves usually require reducers to connect to pipe sizes shown on the drawing.
- D. Use copper tubing in protective conduit when installed below ground.
- E. Swab fittings and valves with manufacturer's recommended cleaning fluid to remove oil and other compounds prior to installation.
- F. Install hangers and supports per ANSI B31.5 and the refrigerant piping manufacturer's recommendations.
- G. Protect refrigerant system during construction against entrance of foreign matter, dirt and moisture. Until assembly, tightly cap open ends of piping and connections to compressors, condensers, evaporators and other equipment.
- H. Pass nitrogen gas through the pipe or tubing to prevent oxidation as each joint is brazed. Cap the system with a reusable plug after each brazing operation to retain the nitrogen and prevent entrance of air and moisture.
- I. Pipe relief valve discharge to outdoors for systems containing more than 45 kg (100 pounds) of refrigerant.

3.02 FIELD QUALITY CONTROL:

A. Field Tests:

After completion of piping installation and prior to initial operation, conduct test on piping system according to ASME B31.5. Furnish materials and equipment required for tests. If the test fails, correct defects and perform the test again until it is satisfactorily done and all joints are proved tight.

Every refrigerant-containing parts of the system that is erected on the premises, except compressors, condensers, evaporators, safety devices, pressure gauges, control mechanisms and systems that are factory tested, shall be tested and proved tight after complete installation, and before operation.

The high and low side of each system shall be tested and proved tight at not less than the lower of the design pressure or the setting of the pressure-relief device protecting the high or low side of the system, respectively. The exceptions are systems erected on the premises using non-toxic and non-flammable Group A1 refrigerants with copper tubing not exceeding 16 mm (0.62 in) O.D. This may be tested by means of the refrigerant charged into the system at the saturated vapor pressure of the refrigerant at 20 degrees C (68 degrees F) minimum.

B. Test Medium:

A suitable dry gas such as nitrogen or shall be used for pressure testing. The means used to build up test pressure shall have either a pressure-limiting device or pressure-reducing device with a pressure-relief device and a gauge on the outlet side. The pressure relief device shall be set above the test pressure but low enough to prevent permanent deformation of the system components.

C. System Test and Charging:

System test and charging shall be as recommended by the equipment manufacturer or as follows:

Connect a drum of refrigerant to charging connection and introduce enough refrigerant into system to raise the pressure to 70 kPa (10 psi) gauge. Close valves and disconnect refrigerant drum. Test system for leaks with halide test torch or other approved method suitable for the test gas used. Repair all leaking joints and retest.

Connect a drum of dry nitrogen to charging valve and bring test pressure to design pressure for low side and for high side. Refer to QUALITY ASSURANCE. Test entire system again for leaks.

Evacuate the entire refrigerant system by the triplicate evacuation method with a vacuum pump equipped with an electronic gauge reading in mPa (microns). Pull the system down to 665 mPa (500 microns) and hold for four hours and then break the vacuum with dry nitrogen (or refrigerant). Repeat the evacuation two more times breaking the third vacuum with the refrigeration to be charged and charge with the proper volume of refrigerant.

END OF SECTION 23 56 50

**SECTION 23 57 00
HVAC: NATURAL GAS PIPING**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 01 and the following listed sections as a minimum, apply fully to work in this section.

Section 23 00 00 MECHANICAL GENERAL REQUIREMENTS

- B. Refer to and coordinate all work with the work of the following listed Sections:

Section 23 01 50 MECHANICAL: VIBRATION ISOLATION
Section 23 02 50 MECHANICAL: PIPE HANGERS AND SUPPORTS
Section 23 03 00 MECHANICAL: FIRE SAFING / FIRESTOPPING

Section 23 04 40 MECHANICAL: PIPE CLEANING TESTING

Section 23 10 00 PLUMBING

Section 23 85 00 HVAC: EQUIPMENT

1.02 SCOPE:

- A. Provide labor, equipment and materials to complete the work indicated on drawings and herein specified.
- B. Work specified within this Section is limited to 5'-0" beyond building limit.
- C. Work required beyond 5 ft. from building limit is specified within Division 33 SITE UTILITIES, PIPING.

1.03 REFERENCES:

- A. The current editions of the following standards are a part of this specification.

ASME B1.1 Unified Screw Threads
ASME B16.3 Malleable Iron Thread Fittings Classes 150 and 300
ASME B16.5 Pipe Flanges and Flanged Fittings
ASME B16.9 Factory made Wrought Steel Butt Welding Fittings
ASME B16.11 Forged Fittings, Socket Welding and Threaded
ASME B16.33 Manually Operated Metallic Gas Valves

ASTM A53	Pipe, Steel, Black, and Hot Dipped, Zinc Coated Welded and Seamless
ASTM A234	Pipe Fittings of Wrought Carbon Steel and Alloy Steel
ANSI Z223.1	National Fuel Gas Code (NFPA 54)
IFG 2003	International Fuel Gas Code 2012

1.04 RELATED WORK:

- A. Work in conjunction with this section shall be as designated below:

General Contractor:

Cutting, Patching, and Painting
Openings in roofs / Flashing
Openings in walls
Equipment foundations and bases
All temporary heating

Electrical Contractor:

Power wiring for electrical equipment provided within this section.

1.05 PROJECT ADMINISTRATION:

- A. Transmit questions, submissions, notices, and correspondence through the general contractor for transmittal to the Architect.
- B. Prepare and transmit to the Architect all submittal requirements within the time period allowed. See Schedule of Submissions.

1.06 SUBMITTALS:

- A. See SUBMITTAL GENERAL REQUIREMENTS within Section 23 00 00.
- B. The following shop drawings shall be prepared (see Section 23 00 00) and submitted for approval within the time period stated: (This listing is not intended to be all-inclusive. Provide submittals for all materials and equipment proposed for use on this project.)

Pipe and fittings
Valves, cocks, unions
Piping specialties
Gauges and instrumentation
Pipe hangers, supports

1.07 PROJECT CLOSEOUT:

- A. Review and provide closeout requirements of this section and Section 23 00 00 Mechanical General Requirements, including:

Testing and Adjusting
Record Drawings
Operating, Maintenance Instructions
Written Guarantee
Operating, Maintenance Manuals
Cleaning
Test Log
Letters of compliance

PART 2 - PIPING PRODUCTS AND INSTALLATION

2.01 PIPING: INSTALLATION, GENERAL:

- A. Arrange and install piping approximately as indicated and as straight, plumb, and direct as possible. Form right angles or parallel lines with building wall. Keep pipe close to walls, partitions and ceilings. Offset only where necessary to follow walls. Where so indicated and wherever possible, conceal piping in building construction before erection of closing construction. When furred spaces are indicated, keep pipes as close to structural members as possible. Piping shall not interfere with openings, doors and windows. Allow for proper clearance at windows, doors, equipment and other building parts such that piping does not interfere with access and building use.
- B. Piping shall be cut accurately to measurements established at the site and shall be installed without springing, forcing and excessive cutting or weakening of building structure. Pipes shall be installed in a manner permitting proper drainage, venting and free expansion and contraction. Changes in direction shall be made with factory-manufactured fittings.
- C. Piping shall not be permitted to be installed within or below floor slabs.
- D. Piping within solid walls shall not be permitted unless installed in chase.
- E. Piping shall not penetrate any air ducts, chutes, stairwells or shafts
- F. Install pipe to allow for expansion without excessive stress on pipe, hangers and building.
- G. Arrange piping passing through floors, walls and other partitions of building construction so that piping is centered in openings / sleeves and is rigidly supported on both sides of openings / sleeves.
- H. Clean pipe, pipe fittings, and valves before erection. Cap or plug open ends of piping and equipment during construction to keep dirt and foreign material out of system.
- I. Before installing, clean black steel pipe and fittings by hammering to loosen scale and rust and flush out with water, or blow out with compressed air or high-pressure steam under controlled safe conditions.
- J. Perform additional cleaning of piping systems as specified in related Sections.

- K. After threading steel pipe, clean pipe ends carefully to remove cutting oil and metal particles.
- L. Unions or flanges shall be used to facilitate piping installation, and shall be installed between shut-off valves and equipment to facilitate removal of equipment for repair.
- M. Provide dielectric unions where pipes of dissimilar metals are joined together.
- N. Branch piping connections from mains to fixed equipment, and connections from risers to horizontal mains, shall have a minimum of three (3) 90 degree elbows and be arranged in swing fashion to permit unrestricted expansion and contraction of piping and minimize stress at connections to risers and fixed equipment.
- O. Do not route pipelines over switchboards, panels, motor control centers, individual motor starters and other electrical equipment.

2.02 PIPING: BUILDING SERVICE ENTRANCE

- A. Natural gas service to the building will be provided by the Utility. Coordinate with the meter location and layout. Review site drawings.
- B. Piping shall enter the building at a minimum of 20" above grade. Provide steel or cast iron sleeve full depth of the building wall with a 1/4" annular space to the piping. Pack annular space with oakum and seal both ends with silicone waterproof construction sealant.

2.03 PIPING: FUEL GAS (NATURAL GAS) 2" and smaller

- A. Scope: Interior of building above grade.
- B. Material: Provide Schedule 40 black steel pipe, seamless Type S or welded Type E, ASTM A53/A52M with 150 psi banded malleable screw fittings ASME B16.3.
- C. Joints: Ream pipe to full inside diameter. Join pipe with teflon tape or joint compound applied to male threads only, in accordance with procedure in U S A Piping Code.
- D. Installation: All piping shall be pitched towards drip legs (6" deep scale pockets with removable cap).
- E. Drip Legs: Provide full size drip legs at all low points and at connections to equipment. Length to be 6 pipe diameters minimum.
- F. Pressure Test: Pneumatic test all piping to a minimum of 30 psig for a period of 4 hours without a loss of pressure.

2.04 PIPING: FUEL GAS (NATURAL GAS) 2-1/2" & LARGER

- A. Scope: Interior of building above grade.
- B. Material: Provide Schedule 40 black steel pipe, seamless Type S or welded Type E, ASTM A53/A52M with 150 psi wrought steel butt-weld fittings ASME B16.9.

- C. Joints: Ream pipe to full inside diameter. Cut pipe in pipe machine, bevel and remove welding slot. Welders shall be certified by National Certified Pipe Welding Bureau and joints shall be in accordance with procedure in U S A Piping Code.
- D. Drip Legs: Provide full size drip legs at all low points and at connections to equipment. Length to be 6 pipe
- E. Pressure Test: Pneumatic test all piping to a minimum of 30 psig for a period of 4 hours without a loss of pressure.

2.05 EQUIPMENT CONNECTIONS:

- A. Coordinate and insure that all equipment is provided with proper gas pressure regulators.
- B. In general the building system supply pressure at the service will be set to 6"WC unless specifically required to be higher.
- C. Install unions at connection to all equipment downstream of isolation valves and dirt legs.

2.06 PIPING: NATURAL GAS RELIEF VENTS

- A. Scope: Extend all gas train relief vents separately and neatly up thru the roof to a safe termination a minimum of 24" above the roof, or at 10'-0" above grade.
- B. Material: Schedule 40 steel
- C. Termination: Provide screened elbow facing down.

2.07 PIPE IDENTIFICATION

- A. Coordinate with other requirements of these specifications to insure that piping is labeled as required.

2.08 VALVES:

- A. Provide valves where indicated and as required for proper operation of the system. Provide throttling valves where regulation of flow is necessary or desirable, check valves where reverse flow is liable under any condition and shut-off valves on all lines connecting to any piece of equipment.

Valves shall be a minimum of 125# standard construction unless noted otherwise.

Valves 2-1/2" and smaller shall be bronze or brass.

Valves 3" and larger shall be iron body bronze mounted flange ends.

- B. Valves shall have the name or trademark of the manufacturer and the guaranteed working pressure cast on the body of the valve.

Manufacturer: Stockham
Milwaukee
Crane
Nibco
Apollo

C. Natural Gas Service:

Gas Shut-Off: 1/2" to 3", Bronze 300#, Screwed Ends, Gate Valve.

Milwaukee	1182
Stockham	B-144
Nibco	T-176-A

Gas Shut-Off: 1/2" to 2" cast bronze 600#, screwed ends, Ball Valve.

Milwaukee	BA-485
Watts	6000-UL
Nibco	T-176-A

2.09 UNIONS:

- A. Provide unions at all equipment connections, and also where indicated, and as required to make future repairs:

Unions 2" and smaller: ASME B16.39 Black malleable iron
Unions larger shall be flanged:

Manufacturers: Stockham, Grinnell;

2.10 DIELECTRIC UNIONS, FLANGES, HANGERS:

- A. Where dissimilar metals connect, provide dielectric unions, dielectric flanges or hangers to prevent electrolysis.

2.11 SLEEVES: PIPE

- A. Walls: Where piping penetrates masonry or concrete walls, provide sch 40 steel pipe sleeve flush with wall, of size to allow passage of pipe insulation.
- B. Floor: Where piping penetrates floor, provide sch 40 steel pipe sleeve extending 1/2" above finished floor, of size to allow passage of pipe insulation.
- C. Fire Stop: Pack sleeve openings full depth with glass wool to seal opening.

2.12 SUPPORTS: PIPE HANGERS:

- A. General: Provide pipe supports, hangers, or other appurtenance to firmly support the piping systems. All pipes shall be independently supported from the building structure and not from other pipes, flues, conduits, ducts or pipe hangers, etc.
- B. Refer to Section 23 02 50 – MECHANICAL PIPE HANGERS AND SUPPORTS for pipe hanging requirements.

2.13 PIPING IDENTIFICATION:

- A. Provide pipe identification as specified within Section 23 00 00 MECHANICAL GENERAL REQUIREMENTS.

END OF SECTION 23 57 00

SECTION 23 76 40
HVAC: ELECTRIC HEATING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 01 and the following listed sections as a minimum, apply fully to work in this section.

Section 23 00 00 MECHANICAL GENERAL REQUIREMENTS

- B. Refer to and coordinate all work with the work of the following listed Sections:

Section 23 00 50 MECHANICAL: ELECTRICAL COMPONENTS

Section 23 01 50 MECHANICAL: VIBRATION ISOLATION
Section 23 03 00 MECHANICAL: FIRE SAFING / FIRESTOPPING

Section 23 90 00 HVAC: CONTROL SYSTEM

Section 23 95 00 HVAC: TESTING ADJUSTING BALANCING

1.02 SCOPE:

- A. Provide labor, equipment and materials to complete the work indicated on drawings and herein specified.

1.03 RELATED WORK:

- A. Work in conjunction with this section shall be as designated below:

General Contractor:

Cutting, Patching, and Painting
Openings in roofs / Flashing
Openings in walls
Equipment foundations and bases
All temporary heating

Electrical Contractor:

Power wiring for electrical equipment provided within this section.

1.04 PROJECT ADMINISTRATION:

- A. Transmit questions, submissions, notices, and correspondence through the general contractor for transmittal to the Architect.

- B. Prepare and transmit to the Architect all submittal requirements within the time period allowed. See Schedule of Submissions.

1.05 SUBMITTALS:

- A. See SUBMITTAL GENERAL REQUIREMENTS within Section 23 00 00.
- B. The following shop drawings shall be prepared (see Section 23 00 00) and submitted for approval within the time period stated: (This listing is not intended to all inclusive – provide submittals for all materials and equipment proposed for use on this project)

- Electric Cabinet Heaters
- Electric Duct Coils
- Electric Wall Heaters
- Electric Unit Heaters

1.06 PROJECT CLOSE-OUT:

- A. Review and provide close-out requirements of this section and Section 23 00 00 Mechanical General Requirements, including:

- Testing and Adjusting
- Operating, Maintenance Instructions
- Written Guarantee
- Lubrication, Filters
- Operating, Maintenance Manuals
- Cleaning

PART 2 – EQUIPMENT

2.01 ELECTRIC DUCT COIL:

- A. Provide electric duct coil of capacity, size as indicated and as manufactured by Indecco, Singer or Chromalox. Units shall be UL approved for zero clearance and shall meet applicable requirements of the National Electric Code.
- B. Units shall be with galvanized steel frame, terminal box, 80% nickel-20% chromium resistance wire, ceramic insulators, thermal cutouts, contactors, factory disconnect, air flow switch, step controller and fuses.

2.02 ELECTRIC CABINET HEATERS: WALL HEATER TYPE:

- A. Provide electric wall heater, where indicated on the drawings. Units to be with built-in thermostatic control unless indicated otherwise. Units shall be complete with surface mounting enclosure where indicated.
- B. As manufacturer by Qmark or engineer approved equal. Refer to the Schedule on the Drawings for Size and capacity.

2.03 ELECTRIC CABINET HEATERS: CENTRIFUGAL FAN TYPE:

- A. Provide electric cabinet heaters, where indicated on the Drawings. Units shall be of the blow-through type with centrifugal blower located below the electric heating bank. Fan discharge shall be baffled to ensure even flow through the heating coil. Unit casing shall be 18 gauge at the sides and 16 gauge at the top and front. Casing shall be internally insulated and shall be complete with factory applied baked enamel finish.
- B. Units shall be complete with internal control transformer for 24 volt control via remote thermostat, automatic thermal protection at heating coil and two speed fan motor with internal overload protection.
- C. As manufacturer by Qmark or engineer approved equal. Refer to the Schedule on the Drawings for Size and capacity.

2.04 ELECTRIC UNIT HEATERS:

- A. Provide electric unit heater, with support brackets, where indicated. Units to be complete with internal control relays. Internal relay shall provide 24 volt current for control via remote thermostat.
- B. As manufacturer by Qmark or engineer approved equal. Refer to the Schedule on the Drawings for Size and capacity.

END OF SECTION 23 76 40

SECTION 23 80 00
HVAC: AIR HANDLING SYSTEM

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 01 and the following listed sections as a minimum, apply fully to work in this section.

Section 23 00 00 MECHANICAL GENERAL REQUIREMENTS

- B. Refer to and coordinate all work with the work of the following listed Sections:

Section 23 00 50 MECHANICAL: ELECTRICAL COMPONENTS

Section 23 01 50 MECHANICAL: VIBRATION ISOLATION

Section 23 02 50 MECHANICAL: PIPE HANGERS AND SUPPORTS

Section 23 03 00 MECHANICAL: FIRE SAFING / FIRESTOPPING

Section 23 04 00 MECHANICAL: INSULATION

Section 23 76 40 HVAC: ELECTRIC HEATING

Section 23 85 00 HVAC: EQUIPMENT

Section 23 90 00 HVAC: CONTROL SYSTEM

Section 23 95 00 HVAC: TESTING ADJUSTING BALANCING

1.02 SCOPE:

- A. Provide labor, equipment and materials to complete the work indicated on drawings and herein specified.

1.03 RELATED WORK:

- A. Work in conjunction with this section shall be as designated below:

General Contractor:

Cutting, Patching, and Painting
Openings in roofs / Flashing
Openings in walls
Equipment foundations and bases
All temporary heating

Electrical Contractor:

Power wiring for electrical equipment provided within this section.
All duct smoke detectors that are a part of the fire alarm system.

1.04 PROJECT ADMINISTRATION:

- A. Transmit questions, submissions, notices, and correspondence through the general contractor for transmittal to the Architect.
- B. Prepare and transmit to the Architect all submittal requirements within the time period allowed. See Schedule of Submissions.

1.05 SUBMITTALS:

- A. See SUBMITTAL GENERAL REQUIREMENTS within Section 23 00 00.
- B. The following shop drawings shall be prepared (see Section 23 00 00) and submitted for approval within the time period stated: (This listing is not intended to all inclusive – provide submittals for all materials and equipment proposed for use on this project)

Air Handling Ductwork Layout Drawings

Air Handling Ductwork Materials

Steel

Flexible duct connectors

Clothes Dryer Vent Terminations

Diffusers, Grilles

Fire Dampers

Installation Instructions
Field installation mock up

Duct Access Panels
Access Panels

Water Heater Venting

Sound lining materials

Louvers

1.06 PROJECT CLOSE-OUT:

- A. Review and provide close-out requirements of this section and Section 23 00 00 Mechanical General Requirements, including:

Testing and Adjusting
Record Drawings
Operating, Maintenance Instructions
Written Guarantee

Lubrication, Filters
Operating, Maintenance Manuals
Cleaning
Test Log
Letters of compliance

PART 2 - PRODUCTS AND INSTALLATION

2.01 DUCTWORK: GENERAL

- A. Provide all labor, materials, equipment, and supplies to fabricate and install all duct systems, including ductwork, fasteners, hangers, braces, caulking, fire stopping, access doors, flexible connections and all other items necessary and required for a complete and economically operated system as indicated.
- B. Provide all labor, materials and supplies to properly install devices in the ductwork, including but not limited to; sensors, fire alarm equipment, control equipment, smoke detectors, flow devices, provided within other sections of the specifications. This work shall be coordinated and installed as required for proper operations.
- C. Unless otherwise stated or indicated all ductwork shall be constructed following SMACNA standards of lock forming galvanized steel (ASTM A527) with a minimum galvanized coating of 0.90 oz./sf.
- D. Maintain the cleanliness of the duct storage and installation work area such that the duct systems are internally clean. Provide temporary mylar caps during construction to insure that construction dust does not enter the duct systems. All duct openings shall be sealed until connected to equipment. Wipe down all exterior surfaces as necessary prior to project completion.

2.02 SHEET METAL DUCTWORK: RECTANGULAR

A. General:

Provide all of the sheet metal work as indicated on the drawings, as specified, and as required for the air handling, ventilation and exhaust systems. Construct ductwork to meet all functional criteria defined in Section 7 of the 1995 SMACNA "HVAC Duct Construction Standards, Metal and Flexible", Second Edition, except as noted: All ductwork will not exceed the deflection limits established in The Uniform Mechanical Code Standard 6-1: Standard for Metal Ducts, 1997 Edition.

Ductwork shop drawings must be properly submitted. Any ductwork installed without prior written approval by the specifier shall be replaced at the expense of the contractor.

The contractor must comply with the enclosed specification in its entirety. If on inspections, the specifier finds changes have been made without prior written approval, the contractor will make the applicable changes to comply with this specification, at the contractor's expense. At the discretion of the specifier, sheet metal gauges, and reinforcing may be randomly checked to verify all duct construction is in compliance.

Erect all ductwork in accordance with the "Standard Practice in Sheet Metal Work" published by the National Association of Sheet Metal Contractors.

B. Duct Sizes / Gauge: Low pressure not to exceed 3" WC static pressure

Rectangular Size	Gauge No.	Center Spacing
0" to 12"	26	48"
13" to 30"	24	48" to 60"
31" to 48"	22	48" to 60"
49" to 60"	20	48" to 60"
61 and more	18	48" to 60"

C. Fabrication:

Provide all ducts true to the dimensions indicated on the drawings.

Galvanized Steel: All interior ducts shall be constructed with G-60 or better galvanized steel conforming to ASTM A 653/A 653M and A 924 Standards, LFQ, chem treat. Exterior ductwork or duct exposed to high humidity conditions (i.e. kitchen exhausts) shall be G-90 or better galvanized steel, LFQ, chemical treat.

Aluminum: If specified, use aluminum alloy sheets, lock forming quality, conforming to ASTM B209, Alloy 3003, Temper H14. Dimensional tolerance per ANSI H35.2.

Rectangular Duct Deflection Limits: Shall conform to the Uniform Mechanical Code Standard 6-1 – Standard for Metal Ducts, 1997 Edition. Maximum allowable deflection for transverse joints and intermediate reinforcements will not exceed 0.250 inch for duct widths up to 100 inches and will not exceed 0.3 percent of the span for widths greater than 100 inches.

Ducts shall be straight and smooth on the inside with neatly finished joints. Outside surfaces shall be finished such that all sharp edges are removed. All notches for connecting sections of duct and all grooving seam notches shall not be cut deeper than necessary to insure tight corners.

Crossbreak all surfaces over 18" wide.

Longitudinal Seams Rectangular: For longitudinal seams, the Pittsburgh lock seam will be used on all ductwork 36" wide and larger, and may be used on ductwork 35" wide and smaller.

D. Joints Rectangular:

To SMACNA standards. Proprietary products must be tested in accordance with SMACNA procedures. Certified test results must be submitted.

Transverse joints, for ductwork 36" wide and larger shall be constructed with duct connector systems as manufactured by:

Ductmate 35 System
Ward Ductconnector

All ductwork shall be constructed in accordance with system manufacturer's recommendations.

Butyl gasket will be used between all flanges.

Slip Joints: Shall be made in the direction of the air flow with slips at least one gauge heavier than the duct, made in the form of a frame, mitered and riveted at corners to prevent leakage. Slip joints will be accepted for use on ductwork 30" wide or less and subjected to 2" static positive pressure or less.

E. Sealing of Duct Joints:

All ducts shall have mastic type sealants conforming to SMACNA's Class A sealing requirements, SMACNA Manual, 1995, Second Edition.

Apply tape over joints on exhaust ductwork joints.

On exposed architectural ductwork in the conditioned space the mastic may be eliminated.

F. Elbows:

Changes in direction, where space permits, shall be fabricated with the inside radius no less than the dimension of the duct in the plane of the elbow. Turning vanes shall be used where short radius or square elbows are used.

G. Turning vanes shall be provided as follows:

Short radius elbows up to 26" in width shall be equipped with one vane.

Short radius elbows greater than 26" in width shall be equipped with two vanes.

Vanes in square elbows shall be spaced on 3" radius on diagonal for ducts up to 24" wide, 5" radius for ducts 25" to 36" wide and 7" radius for ducts over 37" wide.

All vanes must be rigid so as not to rattle or vibrate in the air stream and all raw or sharp edges must be removed from the blades. Turning vanes as manufactured by Tuttle and Bailey Company or equal may be substituted for the above.

All fasteners and attachment supports shall be galvanized steel or of other, corrosion resistant, approved material.

H. Hangers, Supports:

Provide strap duct hangers of 16 gauge, 1" wide for ducts to 30" wide, and of 10 gauge, for ducts over 30" wide.

I. Installation:

No pipes or conduits shall pass through any duct without written approval. Where it is impossible to reroute such pipe or conduit, the duct shall be increased to that point to maintain a constant cross-sectional area and a streamlined enclosure for the pipe shall be provided.

All ducts shall be securely anchored to the building construction in any approved manner and shall be so installed as to be completely free from vibration under all conditions of operation. Horizontal ducts shall be supported with iron hangers from concrete inserts, or beam clamps. Vertical ducts in shafts shall be supported at each floor. The contractor shall furnish and erect all necessary supports and cross framing as required.

The contractor shall be responsible for the coordination of the sheet metal installation with the work of all other trades and shall prepare and submit for approval, shop fabrication drawings for all sheet metal work.

All ducts shall be independently supported from the building structure and not from other ducts, flues, conduits, pipe, pipe hangers etc.

Hangers shall be placed at all elbows and changes of direction and at intervals of no greater than 8'-0". Hangers shall be cross-braced, at proper intervals, to prevent duct sway.

J. Ductwork leakage:

Review all requirements for leakage testing within this section of the specifications

The contractor shall be responsible for the coordination of the sheet metal installation with the work of all other trades

2.03 DUCTWORK: FLAT OVAL AND ROUND

- A. General: Provide single wall flat oval and round ductwork manufactured and fabricated to suit the layout required for the proper air distribution and as indicated on the drawings. All ductwork shall be installed true, parallel or perpendicular and level to building parts in a neat and workmanlike manner.

Manufacturer: McGill Airflow

B. References:

Fundamentals Handbook, 1993, American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE)

Systems and Equipment Handbook, 1996, ASHRAE

HVAC Duct Construction Standards, 1995, Sheet Metal and Air Conditioning Contractors National Association (SMACNA)

HVAC Duct System Design, 1990, SMACNA

Round Industrial Duct Construction Standards, 1997, SMACNA

Single-Wall, Flat Oval Duct and Fittings Dimension Sheets, UMC

- C. Materials: All ductwork shall be constructed in accordance with SMACMA and ASHRAE standards and fabricated from G-90 galvanized steel meeting ASTM A-653 and A924. Gauges shall be in accordance with current SMACNA standards; HVAC Duct Construction Standards 1995.

Spiral Flat Oval Duct:

<u>Width</u>	<u>Gauge</u>
up to 48"	22 g
49" to 72"	20 g

- D. Construction: Provide supply ductwork of round or flat oval type. Duct shall be provided in continuous unjoined lengths wherever possible. Duct sections shall not be less than 10 feet in length except as interrupted by fittings. Reinforcement and bracing shall be installed in accordance with the published details of the spiral duct manufacturer for the size and pressure conditions applicable.
- E. Branch take-offs to be with combination tees. Square elbows shall be with turning vanes.
- F. Flat-oval ductwork for sizes not available in Spiral construction, shall be constructed to the following minimum gauges:

<u>Maximum Width</u>	<u>Gauge</u>
11" to 20"	20 Ga.
21" to 40"	18 Ga.
41" to 70"	16 Ga.

All flat-oval duct, not of spiral construction, shall be adequately braced on 4' centers by reinforced couplings or angle ring flanges to limit the amplitude of wall vibration to + or - .008" and the maximum wall deflection to .52" at 3" s.p. Companion angle flanges shall be used when the maximum width exceeds 41" or when the maximum height exceeds 26".

- G. Joint Sealing: All ductwork shall have all joints sealed with mastic duct joint sealer.

Approved sealer is applied to the male end of the coupling and fittings. After the joint is slipped together, sheetmetal screws are placed 1/2" from the outside of the joints, extending 1" on each side of the joint bead and covering the screw heads. Plastic backed tape is immediately applied over the wet sealer.

The duct sealer must be specifically formulated for the job of sealing the field joints for high pressure systems. The sealer shall be compatible with plastic - backed duct tape so the two shall cure and bond together. Samples of sealer and tape and the specification data sheets shall be submitted to the Owner's representative for approval.

Flanged joints shall be sealed by Neoprene rubber gaskets.

- H. Fabrication: Provide all ducts true to the dimensions indicated on the drawings. Ducts shall be straight and smooth on the inside with neatly finished joints. Outside surfaces shall be finished such that all sharp edges are removed.

Provide ductwork layout drawings indicating all fittings and appurtenances required.

Supply Joint Construction:

Round ductwork

Slip Coupling up to 16"

Flat Oval Ductwork

Slip Coupling up to 25" wide duct
Ovalmate 25" up

- I. Hangers, Supports: Provide strap duct hangers of 16 gauge, 1" wide for ducts to 30" wide, and of 10 gauge, for ducts over 30" wide.

All ducts shall be securely anchored to the building construction in any approved manner and shall be so installed as to be completely free from vibration under all conditions of operation. Horizontal ducts shall be supported with iron hangers from concrete inserts, or beam clamps. Vertical ducts in shafts shall be supported at each floor. The contractor shall furnish and erect all necessary supports and cross framing as required.

- J. Installation: No pipes or conduits shall pass through any duct without written approval. Where it is impossible to reroute such pipe or conduit, the duct shall be increased to that point to maintain a constant cross-sectional area and a streamlined enclosure for the pipe shall be provided.

All ductwork shall be suitable for painting.

The contractor shall be responsible for the coordination of the sheet metal installation with the work of all other trades

2.04 DUCTWORK LEAKAGE TESTING:

- A. Ductwork Leakage Criteria: All transverse joints and longitudinal seams and penetrations shall be sealed to Conform to SMACNA's Class A sealing requirements as defined in the 1995 SMACNA Manual, Second Edition.

Constant Volume Systems/Supply Ductwork

Allowable Leakage-----1% of design cfm

Constant Volume Systems/Return Ductwork

Allowable Leakage-----2% of design cfm

- B. Ductwork Leakage Testing, General:

Installed ductwork shall be tested prior to installation of access doors, take-offs, etc. The engineer or a representative of the engineer shall witness all leak testing. The contractor shall give the engineer 72 hours notice prior to testing. Any testing not witnessed by the engineer or his/her representative, shall be considered invalid and will be redone at the contractor's expense.

- C. The testing shall be performed as follows:

Perform testing in accordance with SMACNA HVAC Air Duct Leakage Test Manual and as follows:

Use a certified orifice tube and its corresponding logarithmic chart for measuring the leakage. Supply fan must have a CFM capacity greater than the allowable leakage in CFM for the section being tested.

Define section of system to be tested and blank off.

Determine the percentage of the system being tested.

Using that percentage, determine the allowable leakage (cfm) for the section being tested.

Pressurize to operating pressure and repair any significant or audible leaks.
Repressurize and measure leakage.

Repeat steps 6 and 7 until the leakage measured is less than the allowable defined in step 5.

D. Ductwork Leakage Testing, Test Pressure Levels:

Pressure levels for ductwork leakage testing shall be as follows:

Fractional Horsepower Supply and Exhaust Systems:	0.50" w.c.
Small Systems, 2000 cfm total air, Supply and Return:	1.00" w.c.
Single Zone and Central Exhaust Systems:	2.00" w.c.
Concealed Supply and Return Risers, (in chases):	3.00" w.c.

E. NOTE: It is recommended that the first 100'-300' of ductwork installed be tested to insure the quality of the workmanship at an early stage.

2.05 FLEXIBLE CONNECTIONS: DUCTWORK

A. At connection of ductwork to air handling equipment, provide flexible material, double layer of fiberglass fabric coated with neoprene, 30 ounce per square yard, rated for 250 deg F continuous use, as manufactured by Ventfabrics Inc or approved equal.

2.06 ADJUSTABLE CONSTANT AIRFLOW REGULATORS

A. General: Provide adjustable constant airflow in all registers, grilles & diffusers as indicated on the contract documents. Constant airflow regulators shall be model CAR-IIA as manufactured by American ALDES Ventilation Corporation or engineer approved equal.

2.07 DAMPERS

- A. General: Provide automatic, manual or splitter type volume dampers as indicated on the drawings and where branch ducts split from main ductwork.
- B. All CAR (constant airflow regulator) dampers shall be located at or near each terminal register so they are readily available during testing & balancing procedures.
- C. All dampers in ductwork connected to the exterior shall achieve a Class 1 or 1A seal rating.
- D. Volume Dampers, Quadrant Type: All dampers shall be (2) gauges heavier than the ducts in which they are installed. Damper blades shall be riveted to the supporting rods. Cast or malleable brackets shall be riveted to the sides of duct to support damper rod and shall have lock type quadrant at one end.
- E. Dampers shall be multi-blade type if cross sectional area of ducts exceeds 1.0 square feet.
- F. Splitter Dampers: Provide at all supply takeoffs and as indicated, splitter dampers of length equal to branch duct width to scoop branch duct air out of main duct air stream. Blade of splitter

damper shall be adjusted by steel rod fastened to the end of the damper and pilot block with set screws.

- G. Access Plate: Provide 6" X 6" minimum access sheet metal plate in duct at location of all volume dampers. Location shall provide hand access to damper blade. Pass insulation over this plate.
- H. Automatic Control Dampers: All automatic dampers shall be provided as specified under Automatic Temperature Control. Install all automatic dampers.

2.08 CEILING RADITION DAMPERS:

A. General:

Furnish and install Ceiling radiation dampers for wood truss applications meeting requirements of UL Standard 555C 4th Edition, per the Detail on the Drawings. Ceiling fire dampers shall be tested and listed for wood truss UL listed ceiling assemblies.

B. Manufacturer:

Unit shall be as manufactured by Greenheck, Model CRD-1WT ceiling radiation damper, or equal as manufactured by Lloyd.

C. Ratings:

Fire Resistance: Dampers shall have a UL 555C fire resistance rating of 1 hour.

Fire Closure Temperature: Each ceiling radiation damper shall be equipped with a factory installed heat responsive device rated to close the damper when the temperature at the damper reaches 165 Deg F.

D. Frame:

Damper frame shall be galvanized steel in gauges required by UL listing R13446) with 1 in. plaster flange around the perimeter.

Frame height 4-7/32 inches for grille type
Frame height 4.81 inches for ducted type

E. Blades:

CRD-1WT series shall be galvanized steel with one set of blades. Blade insulation is provided on ceiling dampers and should be non-asbestos, UL classified material.

Each blade stop (at top and bottom of damper frame) shall occupy no more than 5/8 in. of the damper opening area to allow for maximum free area and to minimize pressure loss across the damper.

F. Fire Closure Device:

Dampers shall be supplied with fusible link.

G. Finish

H. Galvanized Steel

I. Installation:

All installations shall be in accordance with manufacturer's published installation instructions and per the Detail on the Drawings.

2.09 RADIATION DAMPER BOOT CONNECTORS:

A. General:

Where flexible duct connections are required for registers and diffusers requiring the installation of radiation dampers, pre-insulated steel radiation damper boot connections shall be provided.

B. Manufacturer:

Unit shall be as manufactured by Buckley.

C. Product Description:

The radiation damper boots shall be fabricated of 24 ga galvanized steel and fit with round inlet collars to allow ready connection to flexible duct systems. The units shall be complete with a plaster frame and shall be suitably sized to allow incorporation of the required radiation damper register/diffuser and opposed blade volume damper. The outer surface of the damper boot assembly shall be faced with 1-1/2" thick, R-8 fiberglass board insulation with vapor barrier facing.

Refer to the Detail on the Drawings for additional information.

2.10 SOUND INSULATION: DUCTWORK (FIBERGLASS)

A. Install within ductwork where indicated 1/2" thick coated fiberglass duct liner. All airstream surfaces and edges shall have an acrylic coating. Liner shall meet the Life Safety Standards as established by NFPA 90 & 90A and shall not support microbial growth as tested in accordance with ASTM G21 & G22. Sound insulation shall be securely fastened with Type "A" Stick-Klips spaced not more than 12" apart and Type "S" Stick-Klip adhesive and speed clip washers. Sound insulation shall be "Permacoat Linacoustic" as manufactured by Manville or approved equal.

B. Ducts to be sound lined shall be increased in outside dimension to allow size shown to be clear inside dimension.

C. Ducts to be sound lined shall be thermally insulated as required.

D. Scope: Unless indicated differently, sound insulation shall be installed a minimum distance of 5' within supply and return ducts at all air handling units.

2.11 FIRE DAMPERS: STATIC AND DYNAMIC

A. General:

Provide fire dampers to maintain the fire resistance rating of all fire rated wall and floor assemblies. Dampers shall be installed at all rated partitions and floors. Locations shall be as determined by NFPA 90 A & B.

B. Fire dampers shall be UL classified 1-1/2 hour rated dynamic curtain type fire dampers, suitable for application in dynamic or static HVAC systems. All fire dampers shall be designed with external flanges and holding straps to eliminate requirement for retaining angles in metal stud drywall applications.

C. Static Fire Dampers shall be with blades stored out of the air stream for all ducts less than 3 square feet in cross-sectional area.

Manufacturer: Ruskin

Model: IBD2 Style A 3 sf and larger
IBD2 Style B less than 3 sf
All units with factory furnished sleeves.

D. Dynamic Fire Dampers shall be with blades stored out of the air stream for all ducts less than 3 square feet in cross-sectional area.

Manufacturer: Ruskin

Model: DIBD2 Style A 3 sf and larger
DIBD2 Style B less than 3 sf
All units with factory furnished sleeves.

E. Combination fire dampers shall be as manufactured by The Ruskin Company, 3900 Dr. Greaves Road, Kansas City, Missouri 64030.

F. Provide for access to all fusible links with access doors in ductwork and access panels in walls etc. See "Access Doors and Access Panels".

G. References:

CSFM - California State Fire Marshall Listing for Fire Damper and Smoke Damper

NFPA 90A - Installation of Air Conditioning and Ventilating Systems

UL 555 - Standard for Safety; Fire Dampers

H. Submittals:

Product Data: Submit manufacturer's product data.

Submittal data must include installation instruction covering all situations of installation required for the project.

Include dynamic ratings.

Indicate materials, construction, dimensions, and installation details.

Verify conformance to NFPA 90A, UL 555, CSFM, and applicable building code.

I. Mock Up: In addition to the submittal procedure above -- a fire damper shall be installed as a review mockup for field inspection by the Engineer and AHJ prior to approval of the fire damper submittal.

J. Quality Assurance:

The manufacturer shall demonstrate damper capacity to close under HVAC system operating conditions in accordance with UL 555.

Maximum Pressure: 8 inches w.g.
Maximum Air Velocity: 4,596 feet per minute.

K. Delivery, Storage, And Handling:

Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer and material.

Store materials in a dry area indoors, protected from damage and in accordance with manufacturer's instructions.

Handle and lift dampers in accordance with manufacturer's instructions. Protect materials and finishes during handling and installation to prevent damage.

L. Fire Damper Construction:

Fire Rating: UL 555 classified and labeled with maximum velocity/pressure rating as a 1-1/2 hour dynamic fire damper.

Dynamic Closure Rating: Dampers up to 8.25 square feet (0.77 m²), Style A, for vertical mount, classified for dynamic closure to a minimum 2,932 feet per minute (894 m/min) and 4 inches w.g. (1 kPa) static pressure.

Integral Sleeve Frame: Minimum 20 roll formed, galvanized steel, with external flanges and holding straps. Damper sleeves shall not extend more than 6" beyond the face of the wall construction unless provided with integral access doors.

Factory Sealant: Apply to dampers in HVAC systems with pressures to maximum 4 inches w.g. (1 kPa).

Damper Blades:

Style: Curtain type, in air stream.

Action: Spring or gravity closure upon fusible link release.

Orientation: Horizontal.

Material: Minimum 24 gauge (0.6 mm) roll formed, galvanized steel.

Closure Springs: Type 301 stainless steel, constant force type, if required.

M. Temperature Release Device:

The release device shall be fusible link. The operating temperature of the fire damper linkage shall be set to be 50 deg F above the normal system operating temperature, but not less than 160 deg F.

N. Duct Transition Connection:

Ductwork connections shall be selected to conform to the duct type served; Rectangular, Round or oval.

O. Damper Assembly:

Dampers shall be factory assembled complete with all specified accessories and furnished as single units conforming to UL 555.

P. Performance Data:

Damper shall be temperature qualified in accordance with UL 555 as a 1-1/2 hour fire damper. Demonstrate capacity of damper to close in HVAC system operating conditions.

Maximum Pressure: 8 inches w.g. (2 kPa).

Maximum Air Velocity: 4,596 feet per minute (1,401 m/min).

Q. Accessories:

All fire and smoke dampers shall be provided with the following accessories:

Factory Sleeve: All ducted fire and smoke dampers shall be provided complete with a factory fabricated damper sleeve affixed to the damper. The sleeve shall be Minimum 20 gauge (1.0 mm) thickness, minimum 17 inches (432 mm) long. Silicone caulk factory applied to sleeve at damper frame to comply with leakage rating requirements.

Breakaway Connections: Breakaway connections are required on all fire and smoke damper installations unless the damper sleeve is at least 16 gauge galvanized steel. Breakaway connections shall conform to Drivemate, Ductmate or TDF duct construction methods

R. Examination:

Inspect areas to receive dampers. Notify the Engineer of conditions that would adversely affect the installation or subsequent utilization of the dampers. Do not proceed with installation until unsatisfactory conditions are corrected.

S. Installation:

Install dampers at locations indicated on the drawings and in accordance with manufacturer's UL approved installation instructions.

Install dampers square and free from racking with blades running horizontally.

Do not compress or stretch damper frame into duct or opening.

Handle damper using sleeve or frame. Do not lift damper using blades or accessories.

Install bracing for multiple section assemblies to support assembly weight and to hold against system pressure. Install bracing as needed.

2.12 ACCESS DOORS - DUCTWORK:

- A. Provide in all ducts where indicated for access to dampers, coils, volume controls, etc. access doors with continuous hinge and cam lock, or double cam lock if necessary. Units shall be complete with 1" insulation on door, 5/8" knock-over edges, 1/2" wide gasket all around and of a minimum size of 14" X 14" overall.

- B. Units shall be as manufactured by:

Advanced-Air Model E5A or Model E5B.

- C. Units sizes shall be determined by duct size, and purpose of accessibility. All fusible links shall be readily accessible. Access door shall be sized at coils such that door is not less than 8" less than duct size.

2.13 FIRE STOPS: DUCTWORK

- A. Where ducts penetrate walls, floors; seal the space around the duct full depth with mineral wool or other non-combustible material. For oversized openings provide sheet metal closure to hold material in place as necessary.

2.14 AIR DIFFUSERS/GRILLES:

- A. General: Provide all air diffusers, registers and grilles of size and air capacity as indicated on the drawings. Registers and diffusers shall be as manufactured by Price or Tuttle and Bailey.
- B. Ceiling Diffusers: Provide louvered ceiling diffusers with square neck, air patterns as indicated, removable core, with white baked enamel finish; with opposed blade dampers, lay-in type, unless otherwise noted.

Model: Price SMA/AMX

- C. Ceiling Linear Diffusers: Provide linear diffusers for installation in suspended ceiling system, of extruded aluminum construction, with satin finish and with black pattern controllers. Diffuser frames to be coordinated with ceiling system.

Model: Price SDS

- D. Ceiling Exhaust, Return Registers and Transfer Grilles: Provide eggcrate type, aluminum construction, $\frac{1}{2}$ " x $\frac{1}{2}$ " x $\frac{1}{2}$ " grid core, white finish and overlapping frame.

Model: Price 80/81/82 Series

- E. Supply Registers, Grilles; Wall and Ceiling Type: Provide heavy gauge extruded aluminum supply registers and grilles. Units shall be complete with double bank deflection fins, adjustable opposed blade dampers and plaster frames held securely in place if to be mounted in plaster walls or ceilings. Double deflection blades to be set for 22 degree spread unless otherwise indicated. Neck velocities shall not exceed 500 fpm unless specifically otherwise indicated on the drawings

Model: Price 500/600 Series

- F. Supply Registers, Grilles; Sidewall and Duct Mounted: Provide heavy gauge steel supply registers and grilles. Units shall be complete with double bank deflection fins, adjustable opposed blade dampers and plaster frames held securely in place if to be mounted in plaster walls or ceilings. Double deflection blades to be set for 22 degree spread unless otherwise indicated. Neck velocities shall not exceed 500 fpm unless specifically otherwise indicated on the drawings

Model: Price 500/600 Series

- G. Return Grilles: Provide heavy gauge extruded aluminum and steel return grilles of type with 45 degree deflection and 1/2" spacing, as indicated on the drawings. Return grilles over 4 square feet shall be of steel construction.

Model: Price 500/600 Series

2.15 LOUVERS: FIXED

- A. Furnish architectural louvers of size, blade style, frame type and location as indicated on the drawings. Unless specifically noted otherwise on the drawings or herein the fixed louvers shall be as follows:

Construction Specialties	Model: #4157 dual drainable blade type
Greenheck	Model EDD-401 dual drainable blade

- B. Verify size, placement details prior to fabrication. Coordinate shop drawings. Provide installation instructions to installing contractor. Comply with SMACNA recommendations for fabrication, details, and installation procedures except where otherwise indicated.

- C. Finish: Kynar 500 standard color to be approved by Architect.

- D. Materials: Aluminum extrusions; ASTM 221, Alloy 6063-T52
PVC compression gaskets.
Screens: 1/2" mesh, .063 diameter wire.

2.16 LOUVER: INSTALLATION

- A. Locate and place louver units level, plumb, and at indicated alignment with adjacent work. Provide full depth sill pan under all louvers.
- B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.
- C. Form closely fitted joints with exposed connections accurately located and secured.
- D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- E. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes to no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.
- F. Protect galvanized and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.
- G. Install concealed gaskets, flashings, joint fillers, and insulation, as louver installation progresses, where weathertight louver joints are required. Comply with Division 7 Section "Joint Sealants" for sealants applied during louver installation..

2.17 CLOTHES DRYER VENT

- A. Provide clothes dryer vent duct of all aluminum construction from the dryer to the exterior terminal cap. Duct shall be with smooth interior with no connection screws extending to within the duct. Provide telescoping connections in the direction of flow with taped and banded joints. All changes of direction shall be with 45 deg bends unless specifically shown otherwise. Duct shall be coordinated with appliance installation instructions to insure proper venting of the appliance.
- B. Appliance connector: Provide a flexible appliance connector from the appliance to the clothes dryer vent duct. The connector shall be not longer than 60”.
- C. Wall terminal: Provide all aluminum wall terminals with back draft damper and flange for flashing.
- D. Roof terminal: Provide vertical dryer vent terminal as manufactured by C&J Metal Products Inc (www.CJMetals.com) with discharge set 20” clear above roof with tall cone flashing. Duct shall be insulated with minimum of 1” fiberglass from flashing down to 6” below roof opening. Provide drip tight duct to prevent condensation drip staining of building.

PART 3 - INSULATION PRODUCTS AND INSTALLATION

3.01 INSULATION: GENERAL:

- A. Provide all insulation as specified in a neat and workmanlike manner observing the best practices of the trade. All longitudinal seams shall be flat and facing away from view. Insulation shall be smooth throughout. Vapor barriers, where required, shall be continuous. No raw ends of material shall be permitted; cover same with eight ounce canvas or approved equal.
- B. Ductwork and equipment shall be insulated as specified within Section 230400 – MECHANICAL INSULATION.

END OF SECTION 23 80 00

**SECTION 23 85 00
HVAC EQUIPMENT**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 01 and the following listed sections as a minimum, apply fully to work in this section.

Section 23 00 00 MECHANICAL GENERAL REQUIREMENTS

- B. Refer to and coordinate all work with the work of the following listed Sections:

Section 23 00 50 MECHANICAL: ELECTRICAL COMPONENTS

Section 23 01 50 MECHANICAL: VIBRATION ISOLATION

Section 23 02 50 MECHANICAL: PIPE HANGERS AND SUPPORTS

Section 23 03 00 MECHANICAL: FIRE SAFING / FIRESTOPPING

Section 23 04 00 MECHANICAL: INSULATION

Section 23 55 00 HVAC: HYDRONIC SYSTEMS

Section 23 56 50 HVAC: REFRIGERANT SYSTEMS

Section 23 80 00 HVAC: AIR HANDLING SYSTEMS

Section 23 90 00 HVAC: CONTROL SYSTEM

Section 23 95 00 HVAC: TESTING ADJUSTING BALANCING

1.02 SCOPE:

- A. Provide labor, equipment and materials to complete the work indicated on drawings and herein specified.

1.03 RELATED WORK:

- A. Work in conjunction with this section shall be as designated below:

General Contractor:

Cutting, Patching, and Painting
Openings in roofs / Flashing
Openings in walls
Equipment foundations and bases
All temporary heating

Electrical Contractor:

Power wiring for electrical equipment provided within this section.

1.04 PROJECT ADMINISTRATION:

- A. Transmit questions, submissions, notices, and correspondence through the general contractor for transmittal to the Architect.
- B. Prepare and transmit to the Architect all submittal requirements within the time period allowed. See Schedule of Submissions.

1.05 SUBMITTALS:

- A. See SUBMITTAL GENERAL REQUIREMENTS within Section 23 00 00.
- B. The following shop drawings shall be prepared (see Section 23 00 00) and submitted for approval within the time period stated above: (This listing is not intended to all inclusive – provide submittals for all materials and equipment proposed for use on this project)

VRF Systems
Energy Recovery Ventilators
Fans
Supports, curbs, frames, vibration isolators for all equipment

1.06 PROJECT CLOSEOUT:

- A. Review and provide closeout requirements of this section and Section 23 00 00 Mechanical General Requirements, including:

Testing and Adjusting
Record Drawings
Operating, Maintenance Instructions
Written Guarantee
Lubrication
Filters
Operating, Maintenance Manuals
Cleaning
Test Log
Letters of compliance

PART 2 – EQUIPMENT

2.01 FILTER REQUIREMENTS:

- A. Provide filter sets as indicated for the air handling systems to be installed in the project.
- B. All systems shall be installed with filters (construction set) of a rating of MERV 6 or better.

- C. All systems shall have filters replaced for final balancing and commissioning with filters of a rating of MERV 8.

2.02 VRF DUCTLESS HEAT PUMP SYSTEMS:

A. General:

Provide VRF type, ductless heat pump HVAC systems as specified herein and as indicated on the Drawings. Systems shall be of Model and Capacities as indicated in the SCHEDULE on the Drawings.

B. System Description:

The variable capacity, heat pump heat recovery air conditioning system shall be a Mitsubishi Electric CITY MULTI VRF (Variable Refrigerant Flow) zoning system, or equal products as manufactured by LG or Carrier.

The system shall consist of outdoor unit, multiple indoor units, and M-NET DDC (Direct Digital Controls). The sum of connected capacity of all indoor air handlers shall range from 50% to 130% of outdoor rated capacity.

C. Quality Assurance:

The units shall be listed by Electrical Testing Laboratories (ETL) and bear the ETL label.

All wiring shall be in accordance with the National Electrical Code (N.E.C.).

The units shall be manufactured in a facility registered to ISO 9001 and ISO14001 which is a set of standards applying to environmental protection set by the International Standard Organization (ISO).

All units must meet or exceed the 2010 Federal minimum efficiency requirements and the ASHRAE 90.1 efficiency requirements for VRF systems. Efficiency shall be published in accordance with the Air-Conditioning, Heating, and Refrigeration Institute (AHRI) Standard 1230.

A full charge of R-410A for the condensing unit only shall be provided in the condensing unit.

D. Delivery, Storage And Handling:

Unit shall be stored and handled according to the manufacturer's recommendation.

E. Controls:

The control system shall consist of a low voltage communication network of unitary built-in controllers with on-board communications and a web-based operator interface. A web controller with a network interface card shall gather data from this system and generate web pages accessible through a conventional web browser on each PC connected to the network.

Operators shall be able to perform all normal operator functions through the web browser interface.

System controls and control components shall be installed in accordance with the manufacturer's written installation instructions.

Furnish energy conservation features such as optimal start, night setback, request-based logic, and demand level adjustment of overall system capacity as specified in the sequence. System shall provide direct and reverse-acting on and off algorithms based on an input condition or group conditions to cycle a binary output or multiple binary outputs.

Provide capability for future system expansion to include monitoring and use of occupant card access, lighting control and general equipment control.

System shall be capable of email generation for remote alarm annunciation.

Control system start-up shall be a required service to be completed by the manufacturer or a duly authorized, competent representative that has been factory trained in Mitsubishi Electric controls system configuration and operation. The representative shall provide proof of certification for Mitsubishi Electric Controls Applications Training indicating successful completion of no more than two (2) years prior to system installation. This certification shall be included as part of the equipment and/or controls submittals. This service shall be equipment and system count dependent and shall be a minimum of one (1) eight (8) hour period to be completed during normal working hours.

F. Warranty:

The VRF system units shall be covered by the manufacturer's limited warranty for a period of one (1) year parts and seven (7) year compressor to the original owner from date of installation.

All manufacturer technical and service manuals must be readily available for download by any local contractor should emergency service be required. Registering and sign-in requirements which may delay emergency service reference are not allowed.

The VRF system shall be installed by a contractor with extensive CITY MULTI install and service training. The mandatory contractor service and install training should be performed by the manufacturer.

G. Outdoor Heat Pump Units:

General: The Y-Series shall consist of the outdoor unit, indoor units, and M-NET DDC (Direct Digital Controls). The outdoor unit shall be specifically used with indoor VRF components. The outdoor units shall be equipped with multiple circuit boards that interface to the M-NET controls system and shall perform all functions necessary for operation. Each outdoor unit module shall be completely factory assembled, piped, wired, and run tested at the factory. The model nomenclature and unit requirements are shown below. All units requiring a factory supplied twinning kit shall be piped together in the field, without the need for equalizing line(s). If an alternate manufacturer is selected, any additional material, cost, and labor to install additional lines shall be incurred by the contractor. The sum of connected capacity of all indoor air handlers shall range from 50% to 130% of outdoor rated capacity. Outdoor unit shall have a sound rating no higher than 60 dB(A) down to -6°F. At -5°F or less, the outdoor unit shall have a sound rating no higher than 65 dB(A). If an alternate manufacturer is selected, any additional material, cost, and labor to meet published sound levels shall be incurred by the contractor. Both refrigerant lines from the outdoor unit to indoor units shall be individually insulated.

The outdoor unit shall have an accumulator with refrigerant level sensors and controls.

The outdoor unit shall have a high pressure safety switch, over-current protection and DC bus protection.

The outdoor unit shall have the ability to operate with a maximum height difference of 164 feet and have a total refrigerant tubing length of 984 feet. The greatest length is not to exceed 492 feet between the outdoor unit and the indoor units without the need for line size changes or traps. The outdoor unit shall have rated performance for heat operation at -13°F ambient temperature without additional low ambient controls. The unit shall maintain 100% heat output at 0°F without a supplemental heat source or a second compressor to boost low ambient heating performance.

The outdoor unit shall be capable of operating in cooling mode down to 0°F with optional manufacturer supplied low ambient kit.

Manufacturer supplied low ambient kit shall be provided with predesigned control box rated for outdoor installation and capable of controlling kit operation automatically in all outdoor unit operation modes.

Manufacturer supplied low ambient kit shall be listed by Electrical Laboratories (ETL) and bear the ETL label.

Manufacturer supplied low ambient kit shall be factory tested in low ambient temperature chamber to ensure operation. Factory performance testing data shall be available when requested.

The outdoor unit shall have a high efficiency oil separator plus additional logic controls to ensure adequate oil volume in the compressor is maintained.

Heat Interchanger Circuit: The outdoor unit shall contain a heat interchanger circuit for sub-cooling liquid prior to entering the outdoor coil during the heating mode. The interchanger shall be of a copper tube within a tube construction. The interchanger circuit refrigerant flow shall be controlled by an electronic expansion valve.

Unit Cabinet: The casing(s) shall be fabricated of galvanized steel, bonderized and finished with a powder coated baked enamel.

Fan: The outdoor units shall be furnished with one direct drive, inverter driven, variable speed propeller type fan. The fan motor shall have inherent protection, have permanently lubricated bearings, and be completely variable speed. The fan motor shall be mounted for quiet operation. The fan shall be provided with a raised guard to prevent contact with moving parts. The outdoor unit shall have vertical discharge airflow.

Refrigerant: R410A refrigerant shall be required for the outdoor unit systems. Polyolester (POE) oil shall be required. Prior to bidding, manufacturers using alternate oil types shall submit material safety data sheets (MSDS) and comparison of hygroscopic properties for alternate oil with list of local suppliers stocking alternate oil for approval at least two weeks prior to bidding.

Coil: The outdoor coil shall be of nonferrous construction with lanced or corrugated plate fins on copper tubing. The coil fins shall have a factory applied corrosion resistant blue-fin finish. The outdoor coil fins shall have Blue Coat finish for corrosion protection. The coil shall be protected with an integral metal guard. Refrigerant flow from the outdoor unit shall be controlled by means of an inverter driven compressor.

Compressor: Outdoor units shall be equipped with inverter driven scroll hermetic compressor(s) only. Non inverter-driven compressors, which cause inrush current (demand charges) and require larger wire sizing, shall not be allowed. All compressors shall have flash injection for effective low outdoor temperature heating performance. A crankcase heater(s) shall be factory mounted on the compressor(s). Each compressor shall be capable of modulation down to 16% of rated capacity.

The compressor shall be equipped with an internal thermal overload. The compressor shall be mounted to avoid the transmission of vibration.

Electrical: The outdoor unit electrical power shall be 208/230 volts, 3 phase, 60 hertz. The unit shall be capable of satisfactory operation within voltage limitations of 187-228 volts (208V/60Hz) or 207-253 volts (230V/60Hz). The outdoor unit shall be controlled by integral microprocessors. The control circuit between the indoor units and the outdoor unit shall be 24VDC completed using a 2-conductor, twisted pair non-polar shielded cable to provide total integration of the system.

Controls: The outdoor unit shall have the capability of up to 8 levels of demand control for each refrigerant system.

H. 1-WAY CEILING-RECESSED CASSETTE WITH GRILLE INDOOR UNIT

General: The one-way cassette indoor unit shall be factory assembled, wired, and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, an emergency operation function, and a test run switch. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory. The unit shall be suitable for use in plenums in accordance with UL1995 ed 4.

Unit Cabinet: The cabinet panel shall have provisions for a field installed filtered outside air intake, Branch ducting shall be allowed from cabinet, the one-way grille shall be fixed to bottom of cabinet allowing for one-way airflow.

Fan: The indoor fan shall be an assembly with one line-flow fan direct driven by a single motor with permanently lubricated bearings, the indoor fan shall consist of four (4) speeds, Low, Mid1, Mid2, and High.

Filter: Return air shall be filtered by means of a long-life washable permanent filter.

Coil: The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing. The tubing shall have inner grooves for high efficiency heat exchange. All tube joints shall be brazed with phos-copper or silver alloy, the coils shall be pressure tested at the factory, the unit shall be provided with an integral condensate lift mechanism able to raise drain water 23 inches above the condensate pan.

Electrical: The unit electrical power shall be 208/230 volts, 1-phase, 60 hertz, the system shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz) or 207-253 volts (230V/60Hz).

Controls: Indoor unit shall compensate for the higher temperature sensed by the return air sensor compared to the temperature at level of the occupant when in HEAT mode. Disabling of compensation shall be possible for individual units to accommodate instances when compensation is not required, Control board shall include contacts for control of external heat source. External heat may be energized as second stage with 1.8°F – 9.0°F adjustable dead band from set point, Indoor unit shall include no less than four (4) digital inputs capable of being used for customizable control strategies, Indoor unit shall include no less than three (3) digital outputs capable of being used for customizable control strategies, A factory-installed drain pan sensor shall provide protection against drain pan overflow by sensing a high condensate level in the drain pan. Should this occur the control shuts down the indoor unit before an overflow can occur. A thermistor error code will be produced should the sensor activate indicating a fault which must be resolved before the unit re-starts.

I. MEDIUM STATIC CEILING-CONCEALED DUCTED INDOOR UNIT

General: The ceiling-concealed ducted indoor unit shall be factory assembled, wired, and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, and an auto restart function. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory. The unit shall be suitable for use in plenums in accordance with UL1995 ed 4.

Unit Cabinet: The unit shall be ceiling-concealed, ducted—with a 2-position, field adjustable return and a fixed horizontal discharge supply, the cabinet panel shall have provisions for a field installed filtered outside air intake.

Fan: Indoor unit shall feature multiple external static pressure settings ranging from 0.14 to 0.60 in. WG. The indoor unit fan shall be an assembly with statically and dynamically balanced Sirocco fan(s) direct driven by a single motor with permanently lubricated bearings. The indoor fan shall consist of three (3) speeds, High, Mid, and Low plus the Auto-Fan function

Filter: Return air shall be filtered by means of a standard factory installed return air filter.

Coil: The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing. The tubing shall have inner grooves for high efficiency heat exchange. All tube joints shall be brazed with phos-copper or silver alloy, the coils shall be pressure tested at the factory, Coil shall be provided with a sloped drain pan. Units without sloped drain pans which must be installed cockeyed to ensure proper drainage are not allowed, The unit shall be provided with an integral condensate lift mechanism able to raise drain water 27 inches above the condensate pan.

Electrical: The unit electrical power shall be 208/230 volts, 1-phase, 60 hertz, the system shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz) or 207-253 volts (230V/60Hz).

Controls: Indoor unit shall compensate for the higher temperature sensed by the return air sensor compared to the temperature at level of the occupant when in HEAT mode. Disabling of compensation shall be possible for individual units to accommodate instances when compensation is not required, Control board shall include contacts for control of external heat source. External heat may be energized as second stage with 1.8°F – 9.0°F adjustable dead band from set point, Indoor unit shall include no less than four (4) digital inputs capable of being used for customizable control strategies, Indoor unit shall include no less than three (3) digital outputs capable of being used for customizable control strategies.

J. System Controls:

General:

The Controls Network (CMCN) shall be capable of supporting remote controllers, centralized controllers, an integrated web based interface, graphical user workstation, and system integration to Building Management Systems via BACnet[®] and LonWorks[®].

Electrical Characteristics:

The CMCN shall operate at 30VDC. Controller power and communications shall be via a common non-polar communications bus.

Wiring:

Control wiring shall be installed in a daisy chain configuration from indoor unit to indoor unit, to the BC controller (main and subs, if applicable) and to the outdoor unit. Control wiring to remote controllers shall be run from the indoor unit terminal block to the controller associated with that unit.

Control wiring for the Smart ME remote controller shall be from the remote controller to the first associated indoor unit (TB-5) M-NET connection. The Smart ME remote controller shall be assigned an M-NET address.

Control wiring for the Simple MA and Wireless MA remote controllers shall be from the remote controller (receiver) to the first associated indoor unit (TB-15) then to the remaining associated indoor units (TB-15) in a daisy chain configuration.

Control wiring for centralized controllers shall be installed in a daisy chain configuration from outdoor unit to outdoor unit, to the system controllers (centralized controllers and/or integrated web based interface), to the power supply.

The AE-200, AE-50, and EB-50GU centralized controller shall be capable of being networked with other AE-200, AE-50, and EB-50GU centralized controllers for centralized control.

Wiring type:

Wiring shall be 2-conductor (16 AWG), twisted, stranded, shielded wire as defined by the Diamond System Builder output.

Network wiring shall be CAT-5 with RJ-45 connection.

System Controls Network:

The Controls Network (CMCN) consists of remote controllers, centralized controllers, and/or integrated web based interface communicating over a high-speed communication bus. The Controls Network shall support operation monitoring, scheduling, occupancy, error email distribution, personal web browsers, tenant billing, online maintenance support, and

System Configuration:

CMCN: Remote Controllers Backlit Simple MA Remote Controller.

The Backlit Simple MA Remote Controller shall be capable of controlling up to 16 indoor units (defined as 1 group). The Backlit Simple MA Remote Controller shall be compact in size, approximately 3" x 5" and have limited user functionality. The Backlit Simple MA supports temperature display selection of Fahrenheit or Celsius. The Backlit Simple MA Remote Controller shall allow the user to change on/off, mode (cool, heat, auto (R2/WR2-Series only), dry, setback (R2/WR2-Series only) and fan), temperature setting, and fan speed setting and airflow direction. The Backlit Simple MA Remote Controller shall be able to limit the set temperature range from the Backlit Simple MA. The Backlit Simple MA Remote controller shall be capable of night setback control with upper and lower set temperature settings. The room temperature shall be sensed at either the Backlit Simple MA Remote Controller or the Indoor Unit dependent on the indoor unit dipswitch setting. The Backlit Simple MA Remote Controller shall display a four-digit error code in the event of system abnormality/error.

The Backlit Simple MA Remote Controller shall only be used in same group with Wireless MA Remote Controllers, or with other Backlit Simple MA Remote Controllers (PAC-YT53CRAU), with up to two remote controllers per group.

The Backlit Simple MA Remote Controller shall require no addressing. The Backlit Simple MA Remote Controller shall connect using two-wire, stranded, non-polar control wire to TB15 connection terminal on the indoor unit. The Simple MA Remote Controller shall require cross-over wiring for grouping across indoor units.

(Backlit Simple MA Remote Controller)			
Item	Description	Operation	Display
ON/OFF	Run and stop operation for a single group	Each Group	Each Group
Operation Mode	Switches between Cool/Drying/Auto/Fan/Heat/Setback. Operation modes vary depending on the air conditioner unit. Auto and Setback mode are available for the R2/WR2-Series only.	Each Group	Each Group
Temperature Setting	Sets the temperature from 40°F – 95°F depending on operation mode and indoor unit. Separate COOL and HEAT mode set points available depending on central controller and connected mechanical equipment.	Each Group	Each Group
Fan Speed Setting	Available fan speed settings depending on indoor unit.	Each Group	Each Group
Air Flow Direction Setting	Air flow direction settings vary depending on the indoor unit model.	Each Group	Each Group
Permit / Prohibit Local Operation	Individually prohibit operation of each local remote control function (Start/Stop, Change operation mode, Set temperature, Reset filter). *1: Centrally Controlled is displayed on the remote controller for prohibited functions.	N/A	Each Group *1
Display Indoor Unit Intake Temp	Measures and displays the intake temperature of the indoor unit when the indoor unit is operating.	N/A	Each Group
Display Backlight	Pressing the button lights up a backlight. The light automatically turns off after a certain period of time. (The brightness settings can be selected from Bright, Dark, and Light off.)	N/A	Each Unit
Error	When an error is currently occurring on an air conditioner unit, the afflicted unit and the error code are displayed	N/A	Each Unit
Test Run	Operates air conditioner units in test run mode. *2 The display for test run mode will be the same as for normal start/stop (does not display “test run”).	Each Group	Each Group *2
Ventilation	Up to 16 indoor units can be connected to an interlocked	Each	N/A

(Backlit Simple MA Remote Controller)			
Item	Description	Operation	Display
Equipment	system that has one LOSSNAY unit.	Group	
Set Temperature Range Limit	Set temperature range limit for cooling, heating, or auto mode.	Each Group	Each Group

Centralized Controller (Web-enabled):

The Centralized Controller shall be capable of controlling a maximum of two hundred (200) indoor units across multiple outdoor units with the use of three (3) expansion controllers. The Centralized Controller shall be approximately 11-5/32" x 7-55/64" x 2-17/32" in size and shall be powered with an integrated 100-240 VAC power supply.

The Centralized Controller shall support system configuration, daily/weekly scheduling, monitoring of operation status, night setback settings, free contact interlock configuration and malfunction monitoring. When being used alone without the expansion controllers, the Centralized Controller shall have five basic operation controls which can be applied to an individual indoor unit, a collection of indoor units (up to 50 indoor units), or all indoor units (collective batch operation). This basic set of operation controls for the Centralized Controller shall include on/off, operation mode selection (cool, heat, auto (R2/WR2-Series only), dry, setback (R2/WR2-Series only) and fan), temperature setting, fan speed setting, and airflow direction setting. Since the controller provides centralized control it shall be able to enable or disable operation of local remote controllers. In terms of scheduling, the Centralized Controller shall allow the user to define both daily and weekly schedules (up to 24 scheduled events per day) with operations consisting of ON/OFF, mode selection, temperature setting, air flow (vane) direction, fan speed, and permit/prohibit of remote controllers.

(Centralized Controller)			
Item	Description	Operation	Display
ON/OFF	Run and stop operation.	Each Block, Group or Collective	Each Group or Collective
Operation Mode	Switches between Cool/Dry/Auto/Fan/Heat. (Group of Lossnay unit: automatic ventilation/vent-heat/interchange/normal ventilation) Operation modes vary depending on the air conditioner unit. Auto mode is available for the R2/WR2-Series only.	Each Block, Group or Collective	Each Group
Temperature Setting	Sets the temperature from 57°F – 87°F depending on operation mode and indoor unit.	Each Block, Group or Collective	Each Group
Fan Speed Setting	Available fan speed settings depending on indoor unit.	Each Block, Group or Collective	Each Group

(Centralized Controller)			
Item	Description	Operation	Display
Air Flow Direction Setting	Air flow direction settings vary depending on the indoor unit model. *1. Louver cannot be set.	*1 Each Block, Group or Collective	Each Group
Schedule Operation	Annual/weekly/today schedule can be set for each group of air conditioning units. Optimized start setting is also available. The system follows either the current day, annual schedule, or weekly, which are in the descending order of overriding priority. Twenty-four events can be scheduled per day, including ON/OFF, Mode, Temperature Setting, Air Direction, Fan Speed and Operation Prohibition. Five types of weekly schedule (seasonal) can be set. Settable items depend on the functions that a given air conditioning unit supports.	*2 Each Block, Group or Collective	Each Group
Optimized Start	Unit starts 5 - 60 minutes before the scheduled time based on the operation data history in order to reach the scheduled temperature at the scheduled time.	Each Block, Group or Collective	Each Block, Group or Collective
Night Setback Setting	The function helps keep the indoor temperature in the temperature range while the units are stopped and during the time this function is effective.	Each Group	Each Group
Permit / Prohibit Local Operation	Individually prohibit operation of each local remote control function (Start/Stop, Change operation mode, Set temperature, Reset filter). Centrally Controlled is displayed on the remote controller for prohibited functions.	Each Block, Group or Collective	*3 Each Group
Room Temp	Displays the room temperature of the group. Space temperature displayed on the indoor unit icon on the touch screen interface.	N/A	Each Group
Error	When an error is currently occurring on an air conditioner unit, the afflicted unit and the error code are displayed. When an error occurs, the LED flashes. The operation monitor screen shows the abnormal unit by flashing it. The error monitor screen shows the abnormal unit address, error code and source of detection. The error log monitor screen shows the time and date, the abnormal unit address, error code and source of detection.	N/A	*4 Each Unit or Collective
Outdoor Unit Status	Compressor capacity percentage and system pressure (high and low) pressure (excludes S-Series)	Each ODU	Each ODU
Connected Unit Information	MNET addresses of all connected systems	Each IDU, ODU and BC	Each IDU, ODU and BC

(Centralized Controller)			
Item	Description	Operation	Display
Ventilation Equipment	This interlocked system settings can be performed by the master system controller. When setting the interlocked system, use the ventilation switch the free plan LOSSNAY settings between “Hi”, “Low” and “Stop”. When setting a group of only free plan LOSSNAY units, you can switch between “Normal ventilation”, “Interchange ventilation” and “Automatic ventilation”.	Each Group	Each Group
Multiple Language	Other than English, the following language can be chosen. Spanish, French, Japanese, Dutch, Italian, Russian, Chinese, and Portuguese are available.	N/A	Collective
External Input / Output	By using accessory cables you can set and monitor the following. Input By level: “Batch start/stop”, “Batch emergency stop” By pulse: “batch start/stop”, “Enable/disable remote controller” Output: “start/stop”, “error/Normal” Requires the external I/O cables (PAC-YG10HA-E) sold separately.	*5 Collective	*5 Collective

All Centralized Controllers shall be equipped with two RJ-45 Ethernet ports to support interconnection with a network PC via a closed/direct Local Area Network (LAN) or to a network switch for IP communication to up to three expansion controllers for display of up to two hundred (200) indoor units on the main controller interface.

The Centralized Controller shall be capable of performing initial settings via the high-resolution, backlit, color touch panel on the controller or via a PC browser using the initial settings.

Standard software functions shall be available so that the building manager can securely log into each centralized controller via the PC’s web browser to support operation monitoring, scheduling, error email, interlocking and online maintenance diagnostics. Additional optional software functions of personal browser for PCs and MACs and Tenant Billing shall be available but are not included. The Tenant Billing function shall require TG-2000 Integrated System software in conjunction with the Centralized Controllers.

Expansion Controller:

The Expansion Controller shall serve as a standalone centralized controller or as an expansion module to the Centralized Controller for the purpose of adding up to 50 indoor units to either the main touch screen interface of the Centralized Controller. Up to three (3) expansion controllers can be connected to the Centralized Controller via a local IP network (and their IP addresses assigned on the Centralized Controller) to the Centralized Controller to allow for up to two hundred (200) indoor units to be monitored and controlled from the Centralized Controller interface.

The expansion controllers have all of the same capabilities to monitor and control their associated indoor units as the features specified above. Even when connected to the Centralized Controller and configured to display their units on the main controller, the individual indoor units connected to the expansion controller can still be monitored and controlled from the interface of the expansion controller. The last command entered will take precedence, whether at the wall controller, the expansion controller or the Centralized Controller.

K. System Installation:

General:

Rig and install in full accordance with manufacturer's requirements, project drawings, and contract documents. Refer to the manufacturer's installation manual for full requirements.

Location:

Locate indoor and outdoor units as indicated on drawings. Provide service clearance per manufacturer's installation manual. Adjust and level outdoor units on support structure.

For climates that experience snowfall, mount the outdoor unit a minimum of 12" above the average snowfall line. In climates where this height requirement proves unfeasible, the outdoor units may be installed at the average snowfall line provided regular snow removal in the area surrounding the units keeps the snow line below the bottom of the units.

Components / Piping:

Installing contractor shall provide and install all accessories and piping for a fully operational system. Refer to manufacturer's installation manual for full instructions.

Traps, filter driers, and sight glasses are NOT to be installed on the refrigerant piping or condensate lines.

Standard ACR fittings rated for use with R410A are to be used for all connections. Proprietary manufacturer-specific appurtenances are not allowed.

Refrigerant pipe for the VRF system shall be made of phosphorus deoxidized copper, and has two types.

ACR "Annealed": Soft copper pipe, can be easily bent with human's hand.

ACR "Drawn Temper": Hard copper pipe (Straight pipe), being stronger than Type-O pipe of the same radical thickness.

The maximum operation pressure of R410A air conditioner is 4.30 MPa [623psi] . The refrigerant piping should ensure the safety under the maximum operation pressure. Refer to recommend piping specifications in Mitsubishi Electric's engineering manual. Pipes of radical thickness 0.7mm or less shall not be used.

Flare connection should follow dimensions provided in manufacturer's installation manuals.

Piping Insulation:

Refrigerant lines, as well as any valves, shall be insulated end to end with ½" closed-cell pipe insulation for piping up to 1" in diameter, or ¾" for piping 1-1/8" and larger, with a thermal conductivity no greater than 0.27 BTU-in/hr sq.ft °F. If state or local codes require insulation other than that specified above, the greater insulation shall be used.

Electrical:

Installing contractor shall coordinate electrical requirements and connections for all power feeds with electrical contractor.

L. VRF System Commissioning:

General:

The VRF Manufacturer shall oversee and assist the installing contractor with the start up and commissioning of VRF equipment as outlined below. This process will be completed in two phases. Phase one shall cover the Pre-Start-Up inspection process, Phase two will cover the Physical Start-Up & Commissioning of Equipment.

All *VRF System Commissioning* activities shall be completed by an employee of the VRF manufacturer whose primary job responsibilities are to provide start up and commissioning of their products; sales staff or in-house support staffs are not permitted to complete this scope of work.

A factory certified representative may assist the VRF manufacturer's personnel in the completion of certain elements of work contained within this specification. Activities completed by a Factory Certified Representative shall be supervised onsite by the VRF manufacturer. Certified representatives shall not be used in lieu of the manufacturer's personnel.

The installing contractor shall have been certified by the manufacturer to install VRF systems, having attended a minimum 3- day VRF Service & Installation course at an approved training center. A copy of this certificate shall be presented as part of the VRF equipment submittal process.

The installing contractor shall assist the VRF manufacturer in their completion of the system review and have available a technician with appropriate diagnostic tools, materials and equipment, as required, for the duration of the inspection process. The technician shall be fully licensed and insured to complete necessary duties as directed under the supervision of the VRF manufacturer.

Upon completion of the Equipment Start-Up & VRF Commissioning process, the VRF manufacturer shall provide a formal report outlining the status of the system, in electronic format only. Contained within this report shall be copies of all field inspection reports, required action items and status, Manufacturers design software As-Built, equipment model & serial numbers.

Completion of the Equipment Start-Up and VRF Commissioning process shall verify that the VRF system has been installed per the Engineer's design intent and complies with the VRF manufacturers engineering and installation specifications related to their equipment.

Compliance with federal, state and local codes as well as other authorities having jurisdictions are not part of this process and are the responsibility of the installing contractor.

Pre Start-Up Inspection:

Contractor shall employ the services of the VRF manufacturer to provide a comprehensive field review of the completed VRF system installation, prior to the physical start up and operation of equipment. Upon satisfaction that the system meets the VRF manufacturer's installation requirements and specifications, the contractor shall be allowed to proceed with the physical start up and operation of equipment.

Prior to the pre-start-up inspection, all systems components shall be in a final state of readiness having been fully installed and awaiting inspection.

The installing contractor shall provide the VRF manufacturer a copy of the electronic design file used in the design and engineering process of the system being inspected. This electronic design

file shall have been completed on software approved by the specified VRF manufacturer and shall have been updated to reflect as-built conditions.

The installing contractor shall have prepared the refrigeration piping systems per equipment installation and service manuals. All refrigerant piping systems, upon completion of assembly, shall have been pressurized to a minimum 600 PSI, using dry nitrogen, and held for an uninterrupted 24HR period, with acceptable change due to atmospheric conditions. A record of the pressure check process shall be recorded and tagged at the outdoor unit. The tag shall contain the following information: date & time of pressure check start, fill pressure, outdoor temperature at start & stop, date & time of pressure check completion, and the person's full name & company information completing the pressure check.

The installing contractor shall engage the General Contractor as a witness of the pressure check process, confirming that all steps and procedures related to the pressure check were properly followed and that the system held the holding pressure of 600PSI for a period of 24hr hours, with acceptable change due to atmospheric conditions. Witness information, including full name, company name, title, phone number and signature shall be recorded on same pressure tag used by installing contractor.

Upon completion of the 600 PSI pressure check, the system shall be evacuated to a level of 500 microns, where it will be held for a period of 1HR with no deflection. The installing contractor shall utilize the triple evacuation method per the equipment install and service manuals.

Evacuation start & stop dates, times, and persons involved shall be recorded and tagged at the outdoor equipment. Installing contractor shall digitally capture a photo of the micron gauge reading, at the conclusion of the 1hr holding period, for each system and provide a copy to the VRF manufacturer. Each photo shall contain a tag providing the outdoor units Serial number.

Upon the completion of the 500-micron hold, the calculated additional refrigerant charge can be added. The calculated refrigerant charge shall have been calculated using the VRF manufacturers design software.

Total refrigerant charge of the system shall be recorded and displayed at the outdoor unit by permanent means.

A review of the equipment settings shall be completed, with recommendations provided to improve system performance, if applicable. Physical changes of system settings will be completed by the contractor. Electronic recording of final DIP switches shall be provided as part of the commissioning report.

A comprehensive review and visual inspection shall be completed for each piece of equipment following a detailed check list, specific to the equipment being reviewed. A copy of the inspection report shall be provided as part of the manufacturers close out documentation. Any deficiencies found during the inspection process shall be brought to the attention of the installing contractor for corrective action. Any system components that are not accessible for proper inspection shall be noted as such.

Indoor Equipment report shall contain:

- Model & Serial Number
- Equipment location
- Equipment Tag/Identification number
- Network Address & Port Assignment
- Digital recording of equipment settings
- Mounting/support method

- Seismic restraints used
- Proper service clearance provided
- Wiring and connection points are correct
- High voltage reading(s) within acceptable range
- Low voltage reading(s) within acceptable range
- Type of Remote Controller used and its location
- Occupied space temperature sensing location
- Air temperature readings within acceptable range
- Condensate pump interlock method
- Fan E.S.P. setting
- Air Filter condition
- Height differential setting in heat mode
- Noise level acceptable
- Refrigerant pipe connected and insulated properly
- Condensate pipe connected and insulated properly
- Condition of connected ductwork
- Fresh air connected
- Humidifier connected and checked
- Review of air balance report complete
- Other interlocked systems, i.e. baseboard heat, booster fan etc.

Outdoor Air Cooled Equipment Report Shall Contain:

- Model & Serial Number
- Equipment location
- Equipment Tag/Identification number
- Network Address & Port Assignment
- Digital recording of equipment settings
- Mounting/support method
- Seismic restraints used
- High Wind Tethering method
- Proper service clearance provided
- Defrost Condensate removal addressed
- Wiring and connection points are correct
- High voltage reading(s) within acceptable range
- Low voltage reading(s) within acceptable range
- Control Network settings
- Noise level setting
- Refrigerant pipe installed and insulated properly
- Low ambient operation settings

Upon proper equipment start up by the contractor, following the manufacturers guidelines and specifications, an employee of the VRF manufacturer shall complete a review of the system performance and complete the following tasks:

- Check and confirm all communication addressing of system components.
- Check and confirm each indoor unit, individually, is properly piped and wired by commanding the indoor unit on, in either heat or cool mode and verifying proper response.
- This process shall be digitally recorded and included as part of the close out documentation.
- Electronically record a minimum of one-hour of operational data per refrigeration system.
- Electronically record selector switch positions on all indoor and outdoor equipment.

The VRF manufacturer shall retain the electronically recorded data, collected during the start-up and equipment commissioning process, at a designated location within the US for future reference.

M. Close-Out Information:

The VRF manufacturer shall issue a System Performance report at the completion of all fieldwork. Contained within this report shall be an overview of the system performance, recommendations, field reports, all electronic data, and as-built design file.

N. Owner Training and Technical Support:

The VRF manufacturer shall provide the owner's representative a minimum []-hour VRF Operation and Maintenance training class covering systems installed under this scope of work.

Training program is to be provided at the time of owner occupancy.

Owner shall provide a suitable location, onsite, to conduct the VRF Operation and Maintenance class.

Training material shall be provided to participants in electronic format.

Contact your region's Mitsubishi Electric Professional Solutions Manager for information and pricing related to services required under this projects scope of work.

2.03 ENERGY RECOVERY VENTILATOR:

A. Manufacturer Qualifications:

Manufacturer shall regularly engage in the production of heat recovery ventilation equipment.

B. Product Certifications:

Whole unit shall be third-party tested and certified to comply with UL 1812 and CSA C22.2 No. 113.

Unit shall be certified by the Passive House Institute with a minimum heat recovery efficiency of 85%.

Installing contractor to provide calculated fan efficiencies in watts/cfm at the project specific design airflow & static pressure.

C. Warranty:

The heat recovery core shall be warranted against any manufacturing defects or improper workmanship under normal usage for a period of ten years from the unit's date code.

The complete heat recovery ventilator shall be warranted against any manufacturing defects or improper workmanship for a period of two years from the date of installation.

2.04 DELIVERY, STORAGE, AND HANDLING

- A. Store in manufacturer's packaging. Upon delivery confirm all components are present and undamaged by shipping. Products to be installed indoors shall be stored in a dry heated location.

2.05 COORDINATION

- A. Coordinate any required building penetrations for proper size and location with appropriate trades. Coordinate associated plumbing, electrical and roofing systems for installation. Coordinate proper sequencing of construction with all associated trades.

2.06 EXTRA MATERIALS

- A. Provide one set of replacement filters, MERV 13 on intake air stream, MERV 8 on return air stream

2.07 PRODUCTS

- A. Manufacturers

Acceptable Manufacturer: Ventacity Systems Inc, Portland

Substitutions: Equipment with equivalent performance, construction, and certifications to the specified products are acceptable subject to approval by the engineers

- B. General

Construction: ERV shall be a prepackaged unit that is fully assembled at the factory and shall include insulated double wall metal cabinet, rain louvers, motorized intake and exhaust dampers, counter flow fixed plate heat recovery core, ECM motors, direct drive fan assemblies, frost control pre-heater assembly, modulating bypass damper assembly, intake air and return air filter assemblies, temperature and pressure sensors, and control panel assembly. All components to be factory tested and powered by a single electrical connection.

Name Plates: Provide permanent nameplate containing manufacturer name, model number, serial number, voltage, FCA and MCA information.

- C. Cabinet

Cabinet shall be constructed of double-wall insulated panels with thermal breaks to minimize thermal bridging.

- Panels shall be constructed of 0.31" to 0.8" thick galvanized steel. Exterior wall shall be powder coated.
- Insulation should be 2-inch thick of rigid thermoset with 0.013 BTU/(hr-ft-°F) thermal conductivity. Side panels shall also have 0.5" thick K-Flex Eco insulation.
- Panels shall be attached with M8 SHCS fasteners.
- Panels shall be sealed and thermally broken with Soft Polyethylene seals, K-Flex Eco, and Poron UL50E periodic recompression rated gasket material.

- Air intake and exhaust locations shall be protected from water infiltration by integrated louvers constructed of 0.3" thick powder coated galvanized steel with a blade angle of 35 degrees with a secondary 1" 60 degree turn-down lip.
- Supply air and return air shall be configurable for down or end ducting connections.

Doors and access panels shall be constructed of the same materials as the panels

- Doors and access panels shall allow for all routine maintenance and repairs.
- Filters shall be accessible for filter changes through a latched and hinged door.
- Doors and access panels shall be sealed for air tightness with K-Flex Eco, and Poron UL50E periodic recompression rated gasket material.

D. Fans

Fans shall be electronically commutated motor (ECM) integrated direct-drive fan & motor assemblies by EBM Pabst.

- Fan assemblies shall be approved by UL 2111 and CSA C22.2 No. 77
- Motors shall be protection class 1 with internally wired thermal overload protector.
- Motors shall be variable speed.
- Motors shall have sealed ball bearings for maintenance free operation.
- Impellers shall be backwardly curved centrifugal assemblies with factory balancing.
- Impellers shall be constructed of polypropylene plastic.
- Each airstream shall have an independently controlled fan/motor assembly.
- Fans shall be mounted downstream of the heat recovery core.

E. Heat recovery core

Heat exchange core shall be of fixed plate parallel counter flow design.

- Core construction shall be of aluminum plates with 1,500 square feet of surface area.
- Core shall be removable for cleaning and maintenance.
- Core shall be gasketed for air sealing to prevent cross-flow contamination with soft polyethylene seal material.
- Core shall be protected from freezing and frost build-up with a factory installed modulating electric resistance preheater located in the intake air stream and controlled by the exhaust air temperature. Return air bypass through the core and into the supply air stream for frost protection is not allowed.

F. Power and controls

Power:

- Unit shall be powered by choose one (240 VAC, single phase, 60 Hz power)
(208/240 VAC, three phase, 60 Hz power)
- Provide a NEMA 3R Rainproof fused interrupt box type of disconnect switch rated for choose one (240 VAC, single phase, 60 Hz power)
- Unit shall be powered with a single point field connection to power supply.

Controls:

- The ERV shall have the ability to be controlled by a factory provided control system or be able to be monitored and controlled by a building management system (BMS).
- The ERV shall be provided with a factory controls interface panel for remote control and operation of the unit pre-wired to the ERV.
- The control system shall be able to connect to a BMS through Modbus RTU connection protocols.

Sensors: The following sensors shall be included in the ERV:

- Temperature sensors located in each airstream
- Pressure sensors located on both sides of each filter, on the inlet and outlet of each fan, in the supply airstream, and outside of the ERV casing.
- Safety disconnect sensor in the outside air pre-heater

G. Dampers

Bypass damper: The ERV shall have a fully modulating bypass damper assembly to close off intake air through the core and direct it around the core to the supply air side.

- The damper opening bypass chamber shall be interlinked to the damper closing airflow through the core.
- The dampers shall be constructed of double-wall 14 gage galvanized sheet metal.
- The damper blades shall be air sealed upon closing with polymer extrusion blade seals.
- The damper actuator shall be fully modulating with a closing torque of 17.5 in-lb (2 N-m).

Intake and exhaust dampers: The ERV shall include integrated dampers on the intake and exhaust to close these openings for stand-by mode operation or when the unit is powered off.

- The dampers shall be motorized two-position parallel blade dampers.
- Upon start-up, the dampers shall open before the fans operate.
- The dampers shall automatically close in the event of loss of power to the ERV.
- The dampers shall be constructed of double wall extruded aluminum.

The damper blades shall be air sealed upon closing with polymer extrusion blade seals.

The damper actuator shall have a closing torque of 17.5 in-lb (2 N-m).

H. Filters

Filter Racks:

- Filter racks shall be constructed of 0.031" thick galvanized steel designed to hold a 2" thick return filter and 4" thick supply filter.
- Filter racks shall be accessible for changing filters through a latched access door.

Filters:

- The outdoor air shall be filtered with a 4" thick mini-pleat MERV 13 filter.

- The return air shall be filtered with a 2" thick pleated MERV 8 filter.
- The ERV shall have one set of filters pre-installed in the factory.
- Contractor shall provide one set of replacement filters.

I. Vibration isolation

- Mount the ERV onto Curb or stand using a gasket of neoprene material 0.5" thickness and 1.25" width for whole unit vibration protection.
- Connect supply and return ductwork to the ERV using flexible connections for vibration isolation.

J. Examination

Verification of conditions:

- Prior to installation, examine installation site to verify that location is accurate, ductwork penetrations (if required) are correctly sized and located and the roof curb or stand is correct. Consult units IOM to verify correct conditions for installation.
- Verify that electrical rough-in is of the proper size and location for the unit. Consult unit IOM for requirements.
- Verify that any plumbing rough-in required for condensate routing is of the proper size and location. Consult unit IOM for requirements.
- Proceed with installation only once any deficiencies in conditions have been rectified.

K. Installation

Installation shall be performed in accordance with these specifications, engineered mechanical drawings, manufacturer's instructions in the unit IOM, local building code and trade best practices.

L. Cleaning

Clean all filters, air chambers, interior exposed surfaces and exterior faces. Ensure that any loose materials shipped with unit have been removed from the inside. All cleaning must take place prior to commissioning of the unit.

M. System start-up

A. Retain a manufacturer's authorized representative to provide start-up service and commissioning of the ERV. Coordinate with controls commissioning and air flow testing and balancing as necessary.

2.08 INLINE CENTRIFUGAL TYPE EXHAUST AND RETURN EXHAUST FANS; DIRECT DRIVE:

- A. General: The fans shall be duct mounted supply, exhaust or return fans shall be of the centrifugal, direct driven in-line type. Fans shall of capacity and model as indicated in the SCHEDULE on the Drawings and shall be Model manufactured by Greenheck Fan Corporation of Schofield, Wisconsin, Loren Cook or Bailey.
- B. The fan housing shall be of the square design, constructed of heavy gauge galvanized steel and shall include square duct mounting collars.

- C. Fan construction shall include two removable access panels located perpendicular to the motor mounting panel. The access panels must be of sufficient size to permit easy access to all interior components.
- D. The fan wheel shall be centrifugal backward inclined, constructed of aluminum and shall include a wheel cone carefully matched to the inlet cone for precise running tolerances. Wheels shall be statically and dynamically balanced.
- E. Motors shall be permanently lubricated and carefully matched to the fan loads. Motors shall be readily accessible for maintenance.
- F. A NEMA 1 disconnect switch shall be provided as standard, except with explosion resistant motors, where disconnects are optional. Factory wiring shall be provided from motor to the handy box.
- G. All fans shall bear the AMCA Certified Ratings Seal for both sound and air performance.
- H. Each fan shall bear a permanently affixed manufacturer's nameplate containing the model number and individual serial number for future identification.

PART 3 – EXECUTION:

3.01 EQUIPMENT INSTALLATION, GENERAL:

- A. All equipment shall be installed and connected as indicated on the Drawings and in strict accordance with the manufacturer's recommendations. Sufficient clearance to allow effective maintenance shall be provided and sufficient clearance for electrical parts shall be maintained per the requirements of the National Electric Code.

3.02 EQUIPMENT START AND TEST, GENERAL:

- A. All equipment should be started and tested by the HVAC Contractor once the installation is complete and prior to the start of system balancing work.

3.03 FACTORY START AND TEST, GENERAL:

- A. The HVAC Contractor shall schedule manufacturer's start and test work as required such that the work is complete prior to the start of system balancing work. Refer to the individual equipment specifications for manufacturer's start and test requirements.

END OF SECTION 23 85 00

**SECTION 23 90 00
AUTOMATIC CONTROL**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 01 and the following listed sections as a minimum, apply fully to work in this section.

Section 23 00 00 MECHANICAL GENERAL REQUIREMENTS

- B. Refer to and coordinate all work with the work of the following listed Sections:

Section 23 00 50 MECHANICAL: ELECTRICAL COMPONENTS

Section 23 76 40 HVAC: ELECTRIC HEATING

Section 23 85 00 HVAC: EQUIPMENT

Section 23 95 00 HVAC: TESTING ADJUSTING BALANCING

1.02 SCOPE:

- A. Provide labor, equipment and materials to complete the Automatic Control System including modulating (stepping) control.
- B. Provide all equipment, accessories, wiring and instrument appurtenances required for a complete energy efficient functioning system.
- C. The Controls Contractor (ATC) shall provide all power wiring, regardless of voltage, including line voltage wiring to all panels, control devices, not indicated on the Electrical Drawings.
- D. The control system shall consist of, but not be limited to, all controls as specified herein including:
- sensors
 - thermostats
 - switches
 - gradual switches
 - relays
 - wiring, regardless of voltage
 - wiring conduit systems
- E. All materials and equipment used shall be standard components, regularly manufactured for this type of work and shall not be custom designed especially for this project. All components shall have been thoroughly tested and proven in actual use.
- F. Provide all control and interlock wiring for compressor/condenser units, air conditioning units, etc. unless specifically and clearly stated to be provided by others.

- G. The ATC contractor shall review and study all HVAC drawings and the entire PROJECT SPECIFICATION, including Division 1 and Division 23 Specification Sections, to familiarize himself with the equipment and systems operation and to verify the quantities and types of dampers, operators, alarms, bells, etc., he has to provide. Numerous references to the ATC contractor are made throughout this specification identifying work to be performed under the HVAC section in addition to work specifically indicated under this paragraph. It will be assumed that, if no specific inquiries are made during the bidding period, the HVAC/ATC subcontractors have reviewed all requirements and interfaces between equipment and controls, to result in a complete, integrated and fully operational HVAC system.

1.03 RELATED WORK:

- A. Work in conjunction with this section shall be as designated below:

General Contractor: Cutting, Patching and Painting
All Openings in Walls

ATC Contractor: Power wiring for electrical equipment provided within this section.

All power wiring serving the ATC panels shall be provided by the ATC Contractor, unless specifically noted on the electrical drawings.

- B. Provide supervision for the following related work as designated below:

HVAC Contractor: Provide proper auxiliary contacts on motor starters for coordination with controls.

Provide access doors or other approved access means through ceiling and wall assemblies for service of control equipment.

1.04 PROJECT ADMINISTRATION:

- A. Transmit questions, submissions, notices, and correspondence through the general contractor for transmittal to the Architect.
- B. Prepare and transmit to the Architect all submittal requirements within the time period allowed. See Schedule of Submissions.

1.05 SUBMITTALS:

- A. See SUBMITTAL GENERAL REQUIREMENTS within Section 23 00 00.
- B. The following submittals shall be prepared (see Section 23 00 00) and submitted for approval within the time period stated: (This listing is not intended to all inclusive – provide submittals for all materials and equipment proposed for use on this project)

Control Panels
Low Voltage Wiring
Line Voltage Power Wiring

Conduit systems / appurtenances
Wiring Diagrams / Schematics

Sequence of Operations

Operator's User Manual

1.06 QUALITY ASSURANCE/SERVICE RESPONSE:

- A. The Control Contractor shall be fully licensed at the time of bid to do business in the project jurisdiction. The Control Contractor must have a branch office with a technical staff, complete spare parts inventory, and test and diagnostic equipment to keep systems in operation 24 hours per day, seven days per week. He shall have emergency service available in the local area for temperature control systems for which he is currently performing on-call emergency service 24 hours per day, seven days per week.
- B. Installation: None but competent technicians, regularly employed in the control trade, shall install the system.

1.07 EQUIPMENT OPERATION INSTRUCTION AND MAINTENANCE MANUALS:

- A. On completion and acceptance of the work, furnish for approval three copies of written instructions on the proper operation and maintenance of all equipment and apparatus furnished under this Section of the Specification. Refer to Section 23 00 00 for additional requirements.
- B. Each manual shall be provided with an index sheet listing the contents in alphabetical order and shall contain but not limited to the following material:

Updated copies of all submittal data and shop drawings as specified previously.

Manufacturer's instructions regarding the installation, maintenance and calibration of each component used in the ATC system installed by the ATC contractor.

Copies of all warranties and guarantees issued by each equipment manufacturer.

"As-built" interconnecting wiring diagrams and wire lists of the field installed system with complete, properly identified numbering of each system component and device.

A "User's Manual" detailing the operation of the Automatic Control System. The manual shall describe the hardware operation. This manual shall be submitted under separate cover. The User Manual shall be written for an inexperienced user. It shall describe in layman's language, the functions and procedures of "using" the system.

1.08 VALIDATION:

- A. Check out, calibrate and test all connected hardware to insure that the system performs in accordance with the approved specifications and sequences of operation.

1.09 INSTRUCTIONS AND TRAINING:

- A. Provide a knowledgeable technician to instruct the Owner's personnel in the proper operation and maintenance of the system. See SECTION 23 00 00.

B. The ATC contractor shall provide three copies of an operator's user's manual describing all operating and routine maintenance service procedures to be used with the system as specified previously. The ATC contractor shall instruct the Owner's designated representatives in these procedures during the start-up and test period.

C. Material to be covered shall be:

Theory
Operational logic, situations
As installed; Hardware
Troubleshooting
Sequence of operations

1.10 GUARANTEE / WARRANTY:

A. All components, parts and assemblies supplied shall be guaranteed against defects in materials and workmanship for a period of one year.

B. Labor to troubleshoot, repair, or replace system components shall be provided by the Contractor at no charge to the owner during the guarantee period.

1.11 PROJECT CLOSE-OUT:

A. Review and provide close-out requirements of this section and Section 23 00 00 Mechanical General Requirements, including:

Testing and Adjusting
Record Drawings
Operating, Maintenance Instructions
Written Guarantee
Lubrication
Operating, Maintenance Manuals
Cleaning
Instructional Period

PART 2 - PRODUCTS AND INSTALLATION:

2.01 ELECTRIC WIRING: GENERAL:

A. Provide electric wiring and connections required for the automatic control system. Wiring shall be in conduit and shall comply with the Building Code and the NEC.

B. The ATC system shall be installed by skilled electricians who are properly trained and qualified for this work.

C. Supervision and checkout of the system shall be by the ATC contractor.

D. All electric wiring and wiring connections required for the installation of the temperature control system, as herein specified, shall be provided by the temperature control contractor unless specifically shown on the electrical drawings or called for in the electrical specifications.

- E. Power wiring, including line voltage wiring for the control system shall be provided by the temperature control contractor. This power wiring shall be run to a source as directed by the Electrical Engineer.

2.02 SPACE TEMPERATURE THERMOSTATS:

- A. Provide room thermostats where indicated and as required for the sequence of operations. Provide all labor and materials required to install, test and calibrate thermostats provided by others.

2.03 PANELS:

- A. ATC control panels shall be fully enclosed cabinets with all steel construction. Cabinets shall have hinged door with locking latch on cover plate. All cabinet locks shall be common keyed. Cabinets shall be finished with two coats of enamel paint. Panel shall be wall mounted or free standing as located on mechanical drawings.

2.04 MISCELLANEOUS DEVICES:

- A. Provide all necessary relays, low temperature detectors, positioners, electric switches, solenoid valves, clocks, transformers, etc., to make a complete and operable system.

2.05 START-UP AND COMMISSIONING:

- A. General:

When installation of the system is complete, calibrate equipment and verify transmission media operation before the system is placed on-line. All testing, calibrating, adjusting and final field tests shall be completed by the manufacturer. Verify that all systems are operable from local controls in the specified failure mode upon panel failure or loss of power.

Provide any recommendation for system modification in writing to owner. Do not make any system modification, including operating parameters and control settings, without prior approval of owner.

The Temperature Control Contractor shall issue a report based on a sampling of the performance metrics of the system's various control loops. The report shall indicate performance criteria, include the count of conforming and non-conforming system elements, list the non-conforming elements along with performance data.

After manufacturer has completed system start-up and commissioning. Joint commissioning of integrated system segments shall be completed.

2.06 PERFORMANCE VERIFICATION TESTING (PVT) / START-UP AND COMMISSIONING:

- A. General:

When installation of the system is complete, calibrate equipment and verify transmission media operation before the system is placed on-line. All testing, calibrating, adjusting and final field tests

shall be completed by the Temperature Control Contractor. Verify that all systems are operable from local controls in the specified failure mode upon panel failure or loss of power.

Provide any recommendation for system modification in writing to owner. Do not make any system modification, including operating parameters and control settings, without prior approval of owner.

After manufacturer has completed system start-up and commissioning. Joint commissioning of integrated system segments shall be completed.

B. Performance Verification Testing (PVT):

The PVT shall demonstrate compliance of the control system work with the contract requirements. The PVT shall be performed by the Contractor and witnessed and approved by the Owner. A Pre-PVT meeting to review the Pre-PVT Checklist is required to coordinate all aspects of the PVT and shall include the Contractor's QA representative, the Contractor's PVT administrator and the General Contractor's Representative.

Upon successful completion of the PVT, submit a PVT Report to the Owner and prior to the Owner taking use and possession of the facility. Do not submit the report until all problems are corrected and successfully re-tested. The report shall include the annotated PVT Plan used during the PVT. Where problems were identified, explain each problem and the corrective action taken. Include a written certification that the installation and testing of the control system is complete and meets all of the contract's requirements.

C. Performance Verification Testing Plan:

Submit a detailed PVT Plan of the proposed testing for Owner approval. Develop the PVT Plan specifically for the control system in this contract. The PVT Plan shall be a clear list of test items arranged in a logical sequence. Include the intended test procedure, the expected response, and the pass/fail criteria for every component tested.

The plan shall clearly describe how each item is tested, indicate where assisting personnel are required (like the mechanical contractor), and include what procedures are used to simulate conditions. Include a separate column for each checked item and extra space for comments. Where sequences of operations are checked, insert each corresponding routine from the project's sequence of operation. For each test area, include signature and date lines for the Contractor's PVT administrator, the Contractor's QA representative, the General Contractor's representative to acknowledge successful completion.

D. PVT Sample Size:

Test all central plant equipment and primary air handling unit controllers unless otherwise directed. Twenty percent sample testing is allowed for identical controllers typical of terminal control systems, (i.e. fan coil units, heating coils, finned tube radiation, unit heaters).

The owner may require testing of like controllers beyond a statistical sample if sample controllers require retesting or do not have consistent results.

The Owner may witness all testing, or random samples of PVT items. When only random samples are witnessed, the Owner may choose which ones.

E. Pre-Performance Verification Testing Checklist:

Submit the following as a list with items checked off once verified. Provide a detailed explanation for any items that are not completed or verified.

Verify all required mechanical installation work is successfully completed, and all HVAC equipment is working correctly (or will be by the time the PVT is conducted).

- Verify all required control system components, wiring, and accessories are installed.
- Verify all control circuits operate at the proper voltage and are free from grounds or faults.
- Verify all required surge protection is installed.
- Verify all wiring, components, and panels are properly labeled.
- Verify all TAB work affecting controls is complete.
- Verify all sensor readings are accurate and calibrated.
- Verify all electrical interlocks work properly.
- Verify the as-built (shop) control drawings are completed.

F. Conducting Performance Verification Testing:

Conduct Owner-witnessed PVT after approval of the PVT Plan and the completed Pre-PVT Checklist. Notify the General Contractor of the planned PVT at least 15 days prior to testing. Provide an estimated time table required to perform the testing. Furnish personnel, equipment, instrumentation, and supplies necessary to perform all aspects of the PVT.

Ensure that testing personnel are regularly employed in the testing and calibration of temperature control systems.

Using the project's as-built control system (shop) drawings, the project's mechanical design drawings, the approved Pre-PVT Checklist, and the approved PVT Plan, conduct the PVT.

During testing, identify any items that do not meet the contract requirements and if time permits, conduct immediate repairs and re-test. Otherwise, deficiencies shall be investigated, corrected, and re-tested later. Document each deficiency and corrective action taken.

If re-testing is required, follow the procedures for the initial PVT. The Owner may require re-testing of any control system components affected by the original failed test.

G. Nameplates and Tags:

Show the nameplates and tags are accurate and permanently attached to control panel doors, devices, sensors, and actuators.

2.07 TRAINING:

- A. One day of on-site orientation by a system technician who is fully knowledgeable of the specific installation details of the project. This orientation shall, at a minimum, consist of a review of the project as-built drawings and a walk through of the facility to identify panel and device locations.
- B. The Temperature Control Contractor shall provide the Owner's Representative with a binder containing product specific training modules for the system installed. All training shall be held during normal working hours of 8:00 am to 4:30 PM weekdays.

- C. Provide 4 hours of training for Owner's designated operating personnel. Training shall include:
 - Explanation of drawings, operations and maintenance manuals
 - Walk-through of the job to locate control components
 - Explanation of adjustment, calibration and replacement procedures

- D. Since the Owner may require personnel to have more comprehensive understanding of the hardware and software, additional training must be available from the Manufacturer. If such training is required by the Owner, it will be contracted at a later date.

END OF SECTION 23 90 00

SECTION 23 94 00
HVAC CONTROL SEQUENCE OF OPERATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 01 and the following listed sections as a minimum, apply fully to work in this section.

Section 23 00 00 MECHANICAL GENERAL REQUIREMENTS

- B. Refer to and coordinate all work with the work of the following listed Sections:

Section 23 00 50 MECHANICAL: ELECTRICAL COMPONENTS

Section 23 80 00 HVAC: AIR HANDLING SYSTEMS

Section 23 85 00 HVAC: EQUIPMENT

Section 23 90 00 HVAC: CONTROL SYSTEM

Section 23 95 00 HVAC: TESTING ADJUSTING BALANCING

1.02 INTENT:

- A. The intention of these Specifications and Drawings is to call for finished work, debugged, tested and ready for operation.
- B. Equipment and / or materials specified in the singular shall be provided in quantities as required for complete systems.

1.03 GENERAL OPERATIONS

- A. Control sequences are generally worded for direct acting type of control. Controls shall be direct or reverse acting to match the fail position of the actuator or device.
- B. Label function of all control panel alarms switches, indicators, and manual control devices. Label units of analog indicators.

PART 2 - SEQUENCE OF OPERATIONS

2.01 GENERAL DESCRIPTION:

- A. Provide a complete control system with an energy conserving sequence of operations to control the heating, and ventilation systems as indicated for this project.

2.02 VARIABLE REFRIGERANT FLOW (VRF) HVAC CONTROL:

- A. Provide all labor and material required to install, test and calibrate the packaged control system as provided by the HVAC Contractor as a part of the VRF HVAC systems

2.03 AC CONDENSATE INTERLOCK:

- A. The condensate overflow switch at the AC condensate pump shall function to lock out the operation of its related HVAC unit in the event of sensing a high water level, or overflow, of the pump's condensate reservoir or back-up in the units drain pan.

2.04 ELECTRIC CABINET HEATER / UNIT HEATER / KICK SPACE HEATER / WALL HEATER:

- A. Provide all labor and material required to install, test and calibrate the packaged control system as provided by the HVAC Contractor as a part of the electric cabinet heater.

2.05 ENERGY RECOVERY VENTILATOR / IN DUCT HEATING COIL:

- A. The ERV supply and exhaust fans shall operate continuously.
- B. The automatic dampers at the ERV's fresh air inlet and exhaust air outlet louvers shall be in their fully open positions whenever the ERV is operational and shall cycle to their fully closed positions whenever the ERV is not operating.
- C. The in-duct electric heating coil at the ERV unit's fresh air supply connection shall modulate as required to maintain a minimum supply air temperature of 70 deg F, (setpoint variable), whenever the ERV unit is operational.

2.06 DRYER MAKE-UP AIR SUPPLY FAN / IN DUCT HEATING COIL:

- A. The supply fans controller shall monitor laundry room space pressure. On a drop in space pressure by dryer energizing the motorized damper at the intake shall open & exhaust fan shall start and run continuously. The fans controller shall monitor space pressure and increase or decrease fan speed to maintain a field adjustable pressure of -0.02" in relation to the main corridor.
- B. The in-duct electric heating coil at the supply make-up air ductwork shall modulate as required to maintain a minimum supply air temperature of 70 deg F, (setpoint variable), whenever the supply fan is operational.
- C. When the call for make-up air is complete the exhaust fan shall de-energize and the motorized damper shall close.

END OF SECTION 23 94 00

**SECTION 23 95 00
HVAC TESTING ADJUSTING BALANCING**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 01 and the following listed sections as a minimum, apply fully to work in this section.

Section 23 00 00 MECHANICAL GENERAL REQUIREMENTS

- B. Refer to and coordinate all work with the work of the following listed Sections:

Section 23 00 50 MECHANICAL: ELECTRICAL COMPONENTS

Section 23 56 50 HVAC: REFRIGERANT SYSTEMS

Section 23 76 40 HVAC: ELECTRIC HEATING

Section 23 85 00 HVAC: EQUIPMENT

Section 23 90 00 HVAC: CONTROL SYSTEM

Section 23 94 00 HVAC: CONTROL SEQUENCE OF OPERATIONS

1.02 SCOPE:

- A. Provide for an independent balancing concern to provide labor, equipment and materials to complete the Balancing Adjusting Testing of the heating, ventilating and air conditioning system including temperature controls, and interrelated equipment indicated.
- B. This Section specifies the requirements and procedures for testing, adjusting, and balancing air and water distribution systems. Requirements include measurement and establishment of the fluid quantities of the mechanical systems as required to meet design specifications and recording and reporting the results.
- C. Testing, adjusting and balancing is the process of checking and adjusting mechanical system parameters to produce the design objectives. It includes:

Recording temperature entering and leaving all coils (Water and Air)

Adjustment of the total systems to provide the design quantities.

Electrical measurement.

Verification of performance of all equipment and automatic controls.

1.03 RELATED WORK:

- A. Work in conjunction with this section shall be as designated below:

General Contractor:	Access to all equipment coordination.
HVAC Contractor:	Provide coordination and data on equipment furnished.

1.04 PROJECT ADMINISTRATION:

- A. Transmit questions, submissions, notices, and correspondence through the general contractor for transmittal to the Architect.

1.05 NOTIFICATION / COORDINATION:

- A. The balancing concern shall *notify the Engineer at all times when balancing is to be performed*. The general contractor and the HVAC contractor shall insure that all systems are ready for balancing/final adjustment prior to notification of the balancing concern to proceed.
- B. Systems shall be fully operational prior to beginning testing, adjusting, and balancing procedures.

1.06 SUBMITTALS REQUIRED:

- A. Agency Data: Submit proof that the proposed testing, adjusting, and balancing agency meets the qualifications specified below.
- B. Engineer and Technician Data: Submit proof that the Test and Balance Engineer assigned to supervise the procedures, and the technicians proposed to perform the procedures meet the qualifications specified below.
- C. Procedures and Agenda: Submit a synopsis of the testing, adjusting, and balancing procedures and agenda proposed to be used for this project.
- D. Maintenance Data: Submit maintenance and operating data that include how to test, adjust, and balance the building systems. Include this data in the maintenance manual.
- E. Certified Reports: Submit testing, adjusting, and balancing reports bearing the seal and signature of the Test and Balance Engineer. The reports shall be certified proof that the systems have been tested, adjusted, and balanced in accordance with the referenced standards; are an accurate representation of how the systems have been installed; are a true representation of how the systems are operating at the completion of testing, adjusting, and balancing procedures; and are an accurate record of all final quantities measured, to establish normal operating values of the systems.

1.07 SCHEDULE OF SUBMISSIONS:

- A. Balancing Report Prior to substantial completion. 3 Copies.

1.08 QUALITY ASSURANCE:

A. Agency Qualifications:

Employ the services of an independent testing, adjusting, and balancing agency meeting the qualifications specified below, to be the single source of responsibility to test, adjust, and balance the building mechanical systems identified above, to produce the design objectives. Services shall include checking installations for conformity to design, measurement and establishment of the fluid quantities of the mechanical systems as required to meet design specifications, and recording and reporting results.

The independent testing, adjusting, and balancing agency shall be certified by NEEB, TAB and/or SMACNA in those disciplines required for this Project.

B. Codes and Standards:

NEBB: "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems".

ASHRAE: ASHRAE Handbook, 1987 Systems Volume, Chapter 57; Testing, Adjusting, and Balancing.

1.09 BALANCING CONCERN:

A. Selection of the Subcontractor for this work shall be subject to the Owner's approval.

B. Select from the following:

Leonhardt Company, 27 Harvard Street, Brookline, MA
Arden Engineering Service Group, 435 Narragansett Park Dr. Pawtucket, RI.
Thomas-Young Associates, Inc., P.O. Box 567, Marion, MA 02738 (508 748 0204)
Kyle Baker Associates, Poccasett Ave, Providence

1.10 DEFINITIONS:

A. Adjust: To regulate the specified fluid flow rate at the terminal equipment.

B. Balance: To proportion flows within the distribution system (submains, branches, and terminals) according to specified design quantities.

C. Procedure: Standardized approach and execution of a sequence of work operations to yield reproducible results.

D. Report Forms: Test data sheets arranged for collecting test data in logical order for submission and review. These forms should also form the permanent record to be used as the basis for required future testing, adjusting, and balancing.

E. Test: To determine the quantitative performance of equipment.

1.11 COSTS:

- A. Carry the amount proposed from anyone of the listed firms as a part of the base bid. Indicate with the bid which of the listed firms is included within the base bid.

PART 2 – BALANCING / FINAL ADJUSTMENT

2.01 GENERAL:

- A. Test, adjust and balance the systems provided to achieve design operation and to set and mark all adjustable equipment for economical operation.
- B. Obtain design drawings and specifications for the project and become thoroughly acquainted with the design intent.

2.02 PRELIMINARY PROCEDURES FOR AIR SYSTEM BALANCING:

- A. Before operating the system, perform the following steps:

Walk the system from the system air handling equipment to terminal units to determine variations of installation from design.

Check filters for cleanliness.

Verify programming of all Terminal Equipment Controllers is complete.

Coordinate / obtain required software interface software with the Automatic Temperature Control Contractor.

2.03 SYSTEM TESTS, GENERAL:

- A. Scope: Subsequent to final Testing Adjusting and balancing, all control systems shall be adjusted and calibrated such that performance of all equipment is operating as intended.

2.04 ACCEPTANCE TESTING; FIRE DAMPERS:

- A. Scope: Prior to the start of the air balancing work, all fire dampers, smoke dampers and combination fire and smoke dampers shall be performance tested in accordance with the requirements of NFPA-90a.
- B. The fusible links at all dampers shall be removed manually in order to allow a test trip of the dampers. It shall be verified that all dampers close fully and that binding of the damper shutters does not occur.
- C. A summary of damper location and indication of satisfactory or unsatisfactory performance shall be included as a part of the testing and balancing report.

2.05 MEASUREMENTS, INSTRUMENTS AND SUPPLIES:

- A. Provide all required instrumentation to obtain proper measurements. Instruments shall meet the requirements specified in the referenced standards, and shall be calibrated to the tolerances specified therein. Instruments shall be properly maintained and protected against damage.
- B. Use only those instruments that have the maximum field measuring accuracy and are best suited to the measurement being made.
- C. Apply each instrument as recommended by the manufacturer.

2.06 AIR FLOW BALANCE; GENERAL:

- A. Scope: After the completion of the air distribution systems, adjust and balance the systems to deliver air quantities as indicated or as directed.
- B. Perform testing, adjusting, and balancing procedures on each system identified in accordance with the detailed procedures outlined in the referenced standards.
- C. Preliminary Procedures:

Adjust and balance ERV ventilation airflow to the specified design quantities with a tolerance of 100-105%.

Adjust and balance AC units & all other air handling equipment airflow to the specified design quantities with a tolerance of +/-5%.

Adjust and balance supply and return airflows for systems.

Adjust and balance fume hood exhaust airflows. Fume hoods shall be set for a face velocity of 80 fps with the sash at 18 inches. All fume hood exhaust fans shall be set for a discharge outlet velocity of 2500 fps.

Adjust building pressurization for all areas served by systems. Building pressurization is to be measured on each floor in the corridor at one end of the building. The pressurization is to be set at +0.03 inches to 0.05 inches water column with reference to the outside. Each lab space is to be set at a pressurization of -0.01 inches to -0.03 inches with reference to the corridor.

Cut insulation, ductwork, and piping for the installation of test probes to the minimum extent necessary to allow adequate performance of procedures.

Patch insulation, ductwork, and housings using materials identical to those removed.

Seal ducts and test for and repair leaks.

Seal insulation to re-establish integrity of vapor barrier.

Mark equipment settings of controls and devices, to show final settings. Mark with paint or other suitable, permanent identification materials.

Retest, adjust, and balance systems subsequent to significant system modifications, and resubmit test results.

- D. Instruments: Calibrate and maintain all instruments used in checking, balancing the system. Perform accuracy tests on instruments whenever requested by Owner, Engineer, or Architect.
- E. Air Measurement: Measure air quantities in main ducts by pitot tube traverse of the entire cross section area of the duct. Openings in ducts for tests shall be sealed with snap-in plugs after tests. Outlet and inlet air quantities shall be determined by direct reading velocity meters.
- F. Air Quantity Adjustments: Total air quantities shall be obtained by adjusting fan speed. Branch duct quantities shall be adjusted by volume or splitter dampers. Permanently mark set points of all dampers. Only minor air quantity adjustment by outlet dampers will be permitted.
- G. Fresh air intake: Test and set all intake dampers, fans, or other devices to be tight closing when off and to allow stated amounts of fresh air intake during operation. Note all amounts of leakage CFM and operating CFM.
- H. Exhaust systems: Test and set all exhaust dampers, fans, or other device to exhaust the required amounts of air. Set exhaust systems to be tight closing when off. Note all amounts of airflow CFM.
- I. Air System Data:

Fans:	Design RPM Final RPM	Design CFM Final CFM	Design Static Pressure Actual Static Pressure (suction - discharge)
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Fan Motor:	Full Load Amps Operating Amps
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Air system:	Outside air minimum - maximum at economizer cycle. Cooling Coil: air temperature entering-leaving
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Grilles, Registers, Diffusers:

Mark drawings with actual CFM at each outlet, inlet to indicate final adjustment air quantity.

PART 3 - REPORT

3.01 GENERAL:

- A. The balancing concern shall record and submit for evaluation and review three copies of a complete Balancing Report.
- B. Record all data obtained during testing, adjusting, and balancing in accordance with, and on the forms recommended by, the referenced standards.
- C. Prepare a report of recommendations for correcting unsatisfactory mechanical performance when system cannot be successfully balanced or performance tested.

3.02 REPORT FORMAT:

- A. Report forms shall be those standard forms prepared by the referenced standard for each respective item and system to be tested, adjusted, and balanced.
- B. In addition to the Report Forms, the Testing Adjusting and balancing results shall also be noted on reproducible drawings of the building provided by the Architect for that purpose. All data as specified herein shall be neatly and accurately indicated.

3.03 REPORT CONTENTS:

- A. Identification of testing, adjusting, and balancing agency, Owner, and Project. Include addresses, contact names, and telephone numbers.
- B. The seal and name, address, telephone number, and signature of the Test and Balance Engineer.
- C. A listing of the instruments used for the procedures, and proof that all instrumentation has been calibrated to tolerances specified in the referenced standards, within a period of six months prior to starting the project.

END OF SECTION 23 95 00

SECTION 26 0500
BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Work that applies to all sections of DIVISION 26
 - 2. Temporary electrical wiring
 - 3. Supporting devices for electrical components
 - 4. Electrical metering components
 - 5. Electrical services
 - 6. Concrete bases
 - 7. Removals (demolition) and relocations

1.2 RELATED DOCUMENTS

- A. The General Conditions, Supplementary Conditions, and applicable portions of Division 1 of the specification are part of this section which shall consist of all labor, equipment, materials and other costs necessary to complete all **BASIC ELECTRICAL MATERIALS AND METHODS** work indicated on the drawings, herein specified or both.

1.3 RELATED WORK SPECIFIED UNDER OTHER SECTIONS: (Read these DIVISIONS carefully. For purposes of bidding, assume that all work of the DIVISION referenced is to be performed under that DIVISION unless specifically indicated therein to be performed under the ELECTRICAL DIVISION.)

- A. Temporary wiring for building construction - see DIVISION 1.
- B. Concrete - see DIVISION 3.
- C. Painting of all backboards (on all sides and edges before mounting); painting of panels (trims and doors - 2 coats before mounting); painting of exposed electrical raceways, boxes and fittings - see DIVISION 9.
- D. Furnishing of manual and magnetic starters for HVAC equipment - see DIVISION 23.
- E. Temperature controls, temperature control wiring, interlock wiring, and boiler control wiring (except as indicated on the electrical drawings) - see DIVISION 23.

1.4 DEFINITIONS

- A. Provide: Furnish and install.
- B. Wiring: Wire, raceways, boxes and fittings.

1.5 SUBMITTALS

- A. Product Data: For each product indicated
- B. Shop Drawings: Wiring and connection diagrams

- C. Manufacturers: Where the drawings or specifications list specific brands or catalog numbers, only these products may be used unless the words: "or approved equal" or "but are not limited to" are included.
- D. Limitations of approval: The Contractor shall not be relieved of responsibility for deviations from requirements of the Contract Documents by the Engineer's approval of Shop Drawings, Product Data, Samples or similar submittals unless the Contractor has specifically informed the Engineer in writing of such deviation, in a separate cover letter on Contractor's letterhead, at the time of submittal and the Engineer has given written approval to the specific deviation. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples or similar submittals by the Engineer's approval thereof.
- E. Contractor's responsibility: It is the responsibility of the Contractor to check all dimensions and details on shop drawings, before submission to the Engineer, reject same if necessary and only forward to the Engineer shop drawings which he is reasonably certain fulfill the requirements of the contract documents and the work. The approval of shop drawings by the Engineer shall be general only in character and not mean dimensions on drawings have been checked, and will in no way relieve the Contractor of the responsibility for proper fitting and construction of the work, nor from the necessity of furnishing materials or doing the work required by the drawings and/or specifications, which may not be indicated on the shop drawings when approved. All shop drawings shall be checked by the Contractor, and must bear the Contractor's stamp of approval; drawings submitted without this stamp of approval will not be considered.
- F. Samples: Provide all samples requested by the Engineer.
- G. Tests: Test the complete installation to prove it free from shorts, grounds, opens and faulty connections. Make any corrections necessary before acceptance.
 - 1. Test each function of each system including each device.
- H. Fault Current/Coordination Study: Provide a "Fault Current" and "Coordination Study" for the electrical distribution equipment for this project.
- I. Certification: Upon request, provide "Certification" (by a recognized testing agency or a Professional Engineer registered in the state where the project is located) that submitted items of equipment are suitable for their intended use.
- J. Record of Addenda and Change Orders: To avoid overlooking addenda and change order modifications, mark all changes on all copies of drawings and specifications, in a manner acceptable to the Engineer. One method of accomplishing this is to make copies and tape them on the back of the preceding page (tape all edges). Also, circle the changed area and note: see addenda #1, etc. If whole pages or sheets change, either remove the superseded document or put a bold "X" through it.
- K. Record Drawings: Owner's record drawings shall be updated as the project progresses. Maintain documents in a safe, dry location. Indicate clearly and accurately any changes necessitated by field conditions and dimension all raceways built into or under concrete slabs or buried under ground. Contractor to prepare as-built drawings in CAD format at contractor's expense. Contract drawings in CAD format to be furnished to contractor at no cost to contractor. Contractor to provide two compact discs and two hard copies of final as-built drawings.
- L. Operating Instructions and Manuals: Provide the Owner or his representative with complete operating instructions by qualified personnel of all electrical systems. Provide

three (3) bound sets (indexed and bound in three sturdy three-ring binders) of operating and maintenance instructions of all electrical systems employed and all shop drawings.

- M. Manuals: Provide one (1) extra bound set of all shop drawings. Bind in a sturdy 3-ring binder.
- N. Letter of Confirmation: Include in the above manuals a letter confirming that the following items have been completed. Provide written receipt signed by the Owner or his representative indicating that the first 4 items listed below have been received.
1. The number of circuit breaker locks called for have been provided.
 2. Keys have been provided for all locked electrical equipment.
 3. The provisions of the "Operating Instructions and Manuals" paragraph of these specifications have been met.
 4. Spare fuses have been provided.
 5. Identification is complete and in accordance with these specifications.
 6. As-built electrical drawings have been completed and submitted.
 7. All tests are complete and in accordance with these specifications.
 8. All required shop drawings have been submitted and approved.
 9. The entire installation has been accepted by all authorities.

1.6 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Do all wiring and provide all equipment in accordance with the prevailing issue of the National Electrical Code, State Building Code, State Fire Code, OSHA and any additional local rules or requirements.
- C. Obtain and pay for all necessary permits, certificates, etc. Present satisfactory proof of final inspection and approval by all inspection authorities.
- D. Consider the following Industry Standards as minimum requirements for all materials, equipment and systems where such standards are established for materials in question:
1. National Board of Fire Underwriters
 2. National Electrical Manufacturers Association
 3. National Fire Protection Association
 4. Institute of Electrical and Electronic Engineers
 5. Local Electric Utility Company
 6. A nationally recognized testing laboratory (UL, ETL, etc.)
 7. Factory Mutual
 8. Americans with Disabilities Act
- E. Where applicable, this installation shall comply with the following NECA (National Electrical Contractors Association) "National Electrical Installation Standards." Except, if there is a conflict between this specification and these standards, the requirements of this specification shall prevail.
1. NECA 1-2000 Standard Practices for Good Workmanship in Electrical Contracting
 2. NECA 101-2001 Standard for Installing Steel Conduit (Rigid, EMT)

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|----|---------------------|--|
| 3. | NECA 400-1998 | Recommended Practice for Installing and Maintaining Switchboards |
| 4. | NECA/EGSA 404-2000 | Recommended Practice for Installing Generator Sets |
| 5. | NECA/IESNA 500-1998 | Recommended Practice for Installing Indoor Commercial Lighting Systems |
| 6. | NECA/IESNA 501-2000 | Recommended Practice for Installing Exterior Lighting Systems |

1.7 COORDINATION

- A. Coordinate chases, slots, inserts, sleeves, and openings for electrical supports, raceways, and cable with general construction work.
- B. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment that requires positioning before closing in the building.
- C. Coordinate electrical service connections to components furnished by utility companies.
- D. Provide coordination of material and scheduling with all utility company site work.

1.8 SCHEDULING AND SHUTDOWNS:

- A. All work must be scheduled to allow the least interference with the normal operation of the existing facility. Schedule must be arranged to meet the approval of the Owner. All shutdowns of services (power, fire alarm, telephone, etc.) must be approved in writing by the Owner.
- B. All "shutdowns" must be done at other than normal working hours without additional compensation.
- C. Pay all power company charges related to "shutdowns", if any.
- D. All building services (power, fire alarm, telephone, lighting, emergency lighting, exit signs, etc.) must remain in operation during full period of construction. Provide temporary or permanent wiring (if required) to accomplish this.
- E. When an existing fire alarm system is modified or replaced with new, all existing devices must remain in operation until replaced with new devices that are fully tested, approved and operational. All non-functioning equipment shall be so labeled until it is removed or put into service.

1.9 TEMPORARY ELECTRICAL WIRING:

- A. Provide temporary electrical wiring of power and lighting for construction.
- B. Extend service from the electrical system of the existing building. However, if it is necessary to disrupt the existing service, provide new temporary service or generator. Do not overtax the service or distribution system. Provide a portable generator, if necessary.
- C. The Owner to pay the cost of energy consumed.
- D. Service to be 120/240 volts, 1 phase, 3 wire (verify with the General Contractor before installation).

- E. Provide all required connections, panels, circuit breakers, feeders, branch circuit wiring, transformers, lighting fixtures, lamps, receptacles, switches, etc. for a complete and operating temporary electrical system.
 - F. Provide a minimum of 5 footcandles of temporary general illumination throughout the floor area of the building, including all corridors and stairways.
 - G. Existing lighting may be used where it is sufficient and remains energized.
 - H. Provide feeders of sufficient capacity for the requirements of the work, sufficient number of outlets conveniently located so that extension cords not exceeding 100 feet will reach all work requiring artificial light or power.
 - I. All receptacles must be GFCI protected and the entire installation must comply with all applicable OSHA requirements.
 - J. At the end of the day's work, disconnect all lights and power, other than the minimum required security illumination.
 - K. Provide replacement light bulbs and maintenance of the temporary wiring system, as required, throughout the period of construction.
 - L. Conform to all codes and regulations.
 - M. Completely remove temporary wiring system upon completion of construction.
- 1.10 CHANGE ORDERS/PROPOSAL REQUESTS:
- A. During the course of construction, changes in the work may occur. When a significant change is to be made, a Proposal Request will be issued.
 - B. Provide a complete cost breakdown when responding to each Proposal Request.
 - C. Each item of work to be priced separately.
 - D. Each line item to be broken down including quantities and listing separately labor and material.
 - E. Both credits and extras shall be separately and clearly quantified.
 - F. Allowances for overhead and profit shall be as listed in the supplementary conditions.
 - G. If you become aware of a field condition, code requirement, error, or omission that you feel should result in a change to the work, please contact the Engineer for discussion. The Engineer may be able to clarify the situation and avoid unnecessary paperwork.
 - H. It is recognized that the Owner benefits when the construction process is a cooperative effort instead of an adversarial relationship. Reasonable give-and-take allows the construction process to move smoothly. Your efforts in this regard will be appreciated by all parties.
- 1.11 PACKAGED PRICES:
- A. It is in the facility owner's interest, that all bidders receive the best possible quotes on all materials during bidding so that any savings can result in a lower bid price. It is the policy

of this Engineer not to specify brands that will result in "packaged" prices. Upon request, suppliers are to provide bidders with complete material breakdown including each lighting fixture, system, component of system, each piece of equipment, etc. In keeping with this policy, Contractors are hereby cautioned not to anticipate deep discounts after the contract is awarded.

1.12 INSPECTIONS/SITE OBSERVATIONS

- A. The authority having jurisdiction (usually the Municipal Electrical Inspector) shall be notified at periodic intervals that an inspection is requested. Inspections shall be requested at points of progress, meeting the approval of the inspector and as a minimum include the following:
 - 1. Prior to enclosing walls.
 - 2. Prior to enclosing ceilings.
 - 3. Prior to installation of panel panel/switchgear trims/covers.
 - 4. For observation of connections and grounding at switchboards, transformers and generators.

- B. Do not cover the work before the Engineer has had a chance to observe it in completed form. The electrical foreman shall request a meeting with the Engineer within 10 days after the start of electrical construction to assure that there is agreement on the scope of work and to answer questions.

- C. The electrical foreman shall provide assistance to the Engineer during site observations:
 - 1. Describe the progress of the electrical work in detail.
 - 2. Accompany the Engineer on his tour of the site, upon request.
 - 3. Provide use of a suitable ladder, scaffolding or bucket truck to observe the work, upon request.
 - 4. Remove ceiling tiles, panel trims, junction box covers, etc. for observation of the work, upon request.
 - 5. Provide use of project drawings, specifications and shop drawings.

1.13 GUARANTEES/WARRANTIES:

- A. See other portions of the Project Manual for details on Guarantees and Warranties. However, minimum shall be one year from date of acceptance by the Engineer.

- B. The Owner reserves the right to make appropriate modifications or extensions of systems and equipment furnished under this contract during the guarantee/warranty period without "voiding" or modifying the guarantee/warranty of equipment and wiring installed under this contract. If manufacturer voids guarantee, it shall not relieve this contractor of his responsibilities for guarantee/warranty period.

1.14 MISCELLANEOUS

- A. Provide all systems complete. Drawings and Specifications form complementary requirements; provide work specified and not shown, and work shown and not specified as though explicitly required by both.

- B. Although work is not specifically shown or specified, provide supplementary or miscellaneous items, appurtenances, devices and materials obviously necessary for a sound, secure and complete installation.

- C. All wiring and connections to be done with associated circuit de-energized.

PART 2 - PRODUCTS

2.1 MATERIALS - General:

- A. All materials and equipment to be new unless specifically stated otherwise.
- B. Materials and equipment shall be suitable for their intended use and for the environment in which they are installed. For example, equipment located outside shall be weatherproof and constructed of materials that will not rust. This includes brackets, screws, etc.
- C. Coordinate all dimensions to make sure that boxes, raceways, equipment, fixtures, etc., fit properly in the finished construction. If special provisions, such as shallow boxes, are required, they shall be provided at no increase in contract price, regardless of catalog numbers listed in contract documents or on shop drawings.
- D. As it is not practical to enumerate in these specifications (or show on the drawings) all details of fittings and accessory equipment required for proper operation of the various electrical systems herein described, it is understood that they will be supplied without extra compensation. Provide all fittings, terminations, relays, components of panels and equipment, etc., needed for the best performance possible at the present state-of-the-art.

2.2 SUPPORTING DEVICES

- A. Material: Cold-formed steel, with corrosion-resistant coating.
- B. Metal Items for Use Outdoors or in Damp Locations: Hot-dip galvanized steel.
- C. Slotted-Steel Channel: Flange edges turned toward web, and 9/16-inch- (14-mm-) diameter slotted holes at a maximum of 2 inches (50 mm) o.c., in webs. Strength rating to suit structural loading.
- D. Slotted Channel Fittings and Accessories: Recommended by the manufacturer for use with the type and size of channel with which used.
 - 1. Materials: Same as channels and angles, except metal items may be stainless steel.
- E. Raceway and Cable Supports: Manufactured clevis hangers, riser clamps, straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring-steel clamps or click-type hangers.
- F. Pipe Sleeves: ASTM A 53, Type E, Grade A, Schedule 40, galvanized steel, plain ends.
- G. Cable Supports for Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for nonarmored electrical cables in riser conduits. Plugs have number and size of conductor gripping holes as required to suit individual risers. Body constructed of malleable-iron casting with hot-dip galvanized finish.
- H. Expansion Anchors: Carbon-steel wedge or sleeve type.
- I. Toggle Bolts: All-steel springhead type.

2.3 ELECTRICAL IDENTIFICATION

- A. Identification Device Colors: Use those prescribed by ANSI A13.1, NFPA 70, and these Specifications.
- B. Colored Adhesive Marking Tape for Wires and Cables: Self-adhesive vinyl tape, not less than 1 inch wide by 3 mils thick (25 mm wide by 0.08 mm thick).
- C. Tape Markers for Conductors: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.
- D. Underground Warning Tape: Permanent, bright-colored, continuous-printed, vinyl tape compounded for permanent direct-burial service, and with the following features:
 - 1. Not less than 6 inches wide by 4 mils thick (150 mm wide by 0.102 mm thick).
 - 2. Embedded continuous metallic strip or core.
 - 3. Printed legend that indicates type of underground line.
- E. Engraved-Plastic Labels, Signs, and Instruction Plates: Engraving stock, melamine plastic laminate punched or drilled for mechanical fasteners 1/16-inch (1.6-mm) minimum thickness for signs up to 20 sq. in. (129 sq. cm) and 1/8-inch (3.2-mm) minimum thickness for larger sizes. Engraved legend in black letters on white background, unless otherwise indicated.
- F. Warning and Caution Signs: Preprinted; comply with 29 CFR 1910.145, Chapter XVII. Colors, legend, and size appropriate to each application.
 - 1. Interior Units: Aluminum, baked-enamel-finish, punched or drilled for mechanical fasteners.
 - 2. Exterior Units: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate with 0.0396-inch (1-mm), galvanized-steel backing. 1/4-inch (6-mm) grommets in corners for mounting.
- G. Fasteners for Nameplates and Signs: Self-tapping, stainless-steel screws or No. 10/32 stainless-steel machine screws with nuts and flat and lock washers.

2.4 EQUIPMENT FOR UTILITY COMPANY'S ELECTRICITY METERING

- A. Comply with requirements of electrical power utility company for current transformer cabinets and meter sockets.

2.5 CONCRETE BASES

- A. Concrete Forms and Reinforcement Materials: As specified in Division 3 Section "Cast-in-Place Concrete.
- B. Concrete: 3000-psi (20.7-MPa), 28-day compressive strength.

PART 3 - EXECUTION

3.1 ELECTRICAL EQUIPMENT INSTALLATION

- A. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom.

- B. Materials and Components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.
- C. Equipment: Install to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.
- D. Right of Way: Give to raceways and piping systems installed at a required slope.

3.2 LAYOUTS

- A. The electrical system layouts indicated are generally diagrammatic and locations of outlets and equipment are approximate only; govern exact routing of wiring and locations of outlets and equipment by structural conditions and obstructions. This is not to be construed to permit redesigning systems. Interconnect as shown.
- B. Locate all equipment requiring maintenance and operation so that it will be readily accessible. The right is reserved to make any reasonable change in location of outlets and equipment prior to roughing-in without involving additional expense. This may involve slightly longer wiring runs, longer stems, additional mounting provisions, etc. Allow for this in your bid because additional compensation will not be provided. Items not specifically located on the plans shall (for the purposes of bidding) be assumed to be in the farthest, most difficult location. Exact location to be as directed in the field.

3.3 ELECTRICAL SERVICE:

- A. Provide complete electrical service conforming to all requirements of the local electrical utility company, municipality and state.
- B. Service shall be as indicated on the drawings.
- C. Provide connectors for secondary terminations and torque as directed by electric utility company.
- D. Pay all power company charges related to providing service.
- E. Electric utility company to provide the following: primary cable, transformers, meters and current transformers.
- F. Service voltage shall be 208Y/120 volts, 3 phase, 4 wire.
- G. Prior to start of construction, coordinate service with the electric utility company.

Contact: see drawings.

3.4 ELECTRICAL SUPPORTING DEVICE APPLICATION

- A. Damp Locations and Outdoors: Hot-dip galvanized materials, slotted channel system components.
- B. Dry Locations: Steel materials.
- C. Strength of Supports: Adequate to carry present and future loads, times a safety factor of at least four with, 200-lb (90-kg) minimum design load for each support element.

3.5 SUPPORT INSTALLATION

- A. Support parallel runs of horizontal raceways together on trapeze- or bracket-type hangers.
- B. Size supports for multiple raceway or cable runs so capacity can be increased by a 25 percent minimum in the future.
- C. Support individual horizontal single raceways with separate, malleable-iron pipe hangers or clamps except use spring-steel fasteners for 1-1/2-inch (38-mm) and smaller single raceways above suspended ceilings and for fastening raceways to slotted channel and angle supports.
- D. Install sleeves for cable and raceway penetrations of concrete slabs and walls unless core-drilled holes are used. Install sleeves for cable and raceway penetrations of masonry and fire-rated gypsum walls and of all other fire-rated floor and wall assemblies. Install sleeves during erection of concrete and masonry walls.
- E. Secure electrical items and their supports to building structure, using the following methods unless other fastening methods are indicated:
 - 1. Wood: Wood screws or screw-type nails.
 - 2. Gypsum Board: Toggle bolts. Seal around sleeves with joint compound, both sides of wall.
 - 3. Masonry: Toggle bolts on hollow block and expansion bolts on solid block. Seal around sleeves with mortar, both sides of wall.
 - 4. New Concrete: Concrete inserts with machine screws and bolts.
 - 5. Existing Concrete: Expansion bolts.
 - 6. Structural Steel: Welded threaded studs or Spring-tension clamps.
 - a. Comply with AWS D1.1 for field welding.
 - 7. Fasteners for Damp, Wet, or Weather-Exposed Locations: Stainless steel.
 - 8. Light Steel: Sheet-metal screws.
 - 9. Fasteners: Select so load applied to each fastener does not exceed 25 percent of its proof-test load.
 - 10. Light Steel Framing: sheet metal screws.

3.6 IDENTIFICATION MATERIALS AND DEVICES

- A. Provide typewritten directories, not smaller than 5" x 7", mounted under clear plastic affixed to the inside surface of all door-in-trim panels. Information shall include circuit numbers, type of load served and location of load served. For example: #1 Receptacles in rooms 5 & 6.
- B. Label the exterior of switchgear, distribution panels, power and lighting panels, cabinets, each switch of fuse switch panels, each disconnect switch (including those furnished under other sections) with engraved-plastic labels. Provide name of equipment (and use where appropriate). Also, identify each circuit, if a directory is not included. For example: Panel A "Lighting and Power." Provide nameplates called for elsewhere similar to above, unless otherwise noted. Provide a nameplate at each new pilot light. Identification shall include existing panels and equipment modified under this contract and additional existing items, as indicated.
- C. At each pull box, junction box and outlet box, each circuit contained therein shall be identified by panel designation and circuit number. This shall be accomplished by attaching hand written cardboard labels with string to each set of wires or by other agreed upon methods. In addition, where boxes are concealed, covers shall be marked with the same information using magic marker or other agreed upon means.

- D. Install at locations for most convenient viewing without interference with operation and maintenance of equipment.
- E. Coordinate names, abbreviations, colors, and other designations used for electrical identification with corresponding designations indicated in the Contract Documents or required by codes and standards. Use consistent designations throughout Project.
- F. Tag and label circuits designated to be extended in the future. Identify source and circuit numbers in each cabinet, pull and junction box, and outlet box.
- G. Install continuous underground plastic marker tape with foil back during trench backfilling, for exterior underground power, control, signal, and communication lines located directly above power and communication lines. Locate 12 inches above the underground installation. If width of multiple lines installed in a common trench or concrete envelope does not exceed 16 inches (400 mm), overall, use a single line marker.
- H. Install warning, caution, and instruction signs where required to comply with 29 CFR 1910.145, Chapter XVII, and where needed to ensure safe operation and maintenance of electrical systems and of items to which they connect. Indoors install engraved plastic-laminated instruction signs with approved legend where instructions are needed for system or equipment operation. Install metal-backed butyl signs for outdoor items.

3.7 COLOR CODE:

- A. Secondary service, feeders, and branch circuit conductors shall be color-coded as follows:

Phase	240/120 Volts	208/120 Volts	480/277 Volts
A	Black	Black	Brown
B	Red	Red	Orange
C		Blue	Yellow
Neutral	White	White	Gray
Ground	Green	Green	Green

- B. Permanently post at each panel.

3.8 SEQUENCE AND BALANCE:

- A. Maintain correct phase sequence of all feeders and circuits by establishing phase identification and maintaining correct relationship throughout the system. Provide line balance within 10% of normal loads.

3.9 ELECTRICITY-METERING EQUIPMENT

- A. Make provisions for utility company metering equipment according to utility company's written requirements. Provide grounding and empty conduits as required by utility company.

3.10 FIRESTOPPING

- A. Apply firestopping to cable and raceway sleeves and other penetrations of fire-rated floor and wall assemblies to restore original undisturbed fire-resistance ratings of assemblies.

- B. Penetrations through exterior surfaces shall be made watertight.
- C. Floor boxes, fed from floor below, shall be fire-rated, poke-through type with UL labeled fire rating to match floor rating.

3.11 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger, in both directions, than supported unit. Follow supported equipment manufacturer's anchorage recommendations and setting templates for anchor-bolt and tie locations, unless otherwise indicated.

3.12 WORK INTERFERING WITH EXISTING WIRING:

- A. Make any necessary re-circuiting, extensions of existing circuits and relocations required to properly re-energize remaining existing devices or equipment that may be interfered with by new construction or removals.

3.13 REMOVALS (DEMOLITION) AND RELOCATIONS:

- A. Coordinate with DIVISION 2 section "Selective Demolition."
- B. Do all removal work in a neat and orderly manner so as not to endanger lives nor cause damage. Removal work to include all associated hangers, couplings, supports, raceway and wiring, etc., and shall be complete in every way.
- C. Remove and dispose of, off-site in a legal manner, all raceways and wire indicated to be removed.
- D. Carefully remove and store on-site, where directed by the Owner, all electrical equipment indicated to be REMOVED. After the Owner has examined this equipment, remove and dispose of, off-site in a legal manner, all of this equipment that the Owner does not want. All remaining equipment shall remain the property of the Owner. Relocate the remaining equipment to a permanent storage location on site where directed by the Owner.
- E. The electrical removal (demolition) drawings show the general extent of removals. However it is impractical to show every item; some of which may be concealed. Therefore, assume that you will be required to perform an additional 10% of removal work, without additional compensation. Items not shown to be removed or to remain shall remain or be removed, as directed.
- F. Prior to removing any electrical equipment, properly de-energize all associated wiring. Remove wires from terminals of supply switches or circuit breakers. Properly tape supply and load end conductors of all wiring remaining and not re-used. Properly tag both ends.
- G. Provide outlet boxes, knock-out seals, receptacle cover plates, etc. to leave remaining installation in finished condition.
- H. Take special care in removing equipment indicated to be RELOCATED and properly and thoroughly clean and lubricate this equipment. Renew fuses and overload elements in starters and switches being relocated, if required to properly serve the new installation.
- I. Adjust outlet and junction boxes as required to suit new finished surfaces.

- J. When necessary to perform your work, carefully remove ceiling tiles and properly re-install them. Make sure that hands are clean and take special care to avoid damage. If tiles become damaged, provide new tiles to exactly match existing. If existing tiles have yellowed with age, it may be necessary to relocate existing undamaged tiles from utility spaces (closets, etc.) and install new tiles in their place.
 - K. For relocation of lighting fixtures, see sections entitled "Interior Lighting" and "Exterior Lighting."
 - L. Protect existing electrical equipment and installations indicated to remain. If damaged or disturbed in the course of the Work, remove damaged portions and install new products of equal capacity, quality, and functionality.
 - M. Accessible Work: Remove exposed electrical equipment and installations, indicated to be demolished, in their entirety.
 - N. Abandoned Work: Cut and remove buried raceway and wiring, indicated to be abandoned in place, 2 inches (50 mm) below the surface of adjacent construction. Cap raceways and patch surface to match existing finish.
 - O. Remove, store, clean, reinstall, reconnect, and make operational components indicated for relocation.
- 3.14 CORE DRILLING:
- A. All holes through masonry surfaces must be "core drilled". This trade (specification section) is responsible for its respective core drilling, if any.
 - B. Do not endanger any work by drilling or altering work or any part of it.
 - C. Do not drill or alter work of another Contractor without written consent of the Engineer.
 - D. Prior to drilling which affects structural safety of project, or work of another Contractor, submit written notice to the Engineer, requesting consent to proceed with cutting.
 - E. Perform all work of core drilling to perfectly match the quality as specified throughout these specifications.
- 3.15 CLEANING, PAINTING AND REFINISHING:
- A. Paint all new plywood backboards on all sides and edges before mounting, under DIVISION 9.
 - B. Thoroughly clean all new electrical equipment, devices and enclosures upon completion of all work.
 - C. Refinish any new electrical equipment whose finish is damaged or rusted, as determined by the Engineer.

END OF SECTION

SECTION 26 0519
CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes building wires and cables and associated connectors, splices, and terminations for wiring systems rated 600 V and less.

1.2 RELATED DOCUMENTS:

- A. The General Conditions, Supplementary Conditions, and applicable portions of Division 1 of the specification are part of this section which shall consist of all labor, equipment, materials and other costs necessary to complete all **CONDUCTORS AND CABLES (copper only)** work indicated on the drawings, herein specified or both.
- B. The applicable portions of section 260500 BASIC ELECTRICAL MATERIALS AND METHODS are hereby make a part of this section. It is important that you read that section carefully because it expands upon the requirements herein.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.

2.2 CONDUCTORS AND CABLES

- A. Refer to Part 3 "Conductor and Insulation Applications" Article for insulation type, cable construction, and ratings.
- B. Conductor Material: Copper complying with NEMA WC 5 solid conductor for No. 10 AWG and smaller, stranded for No. 8 AWG and larger.
- C. Conductor Insulation Types: Type THHN-THWN or XHHW complying with NEMA WC 5.
- D. Multiconductor Cable: Metal-clad cable, Type MC.
- E. Multiconductor Cable: Type NM.

2.3 CONNECTORS AND SPLICES

- A. Description: Spring type factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated. **Push in type are not acceptable.**

PART 3 - EXECUTION

3.1 CONDUCTOR AND INSULATION APPLICATIONS

- A. Service Entrance: Type THHN-THWN or XHHW, single conductors in raceway.
- B. Exposed Feeders: Type THHN-THWN, single conductors in raceway or MC cable.
- C. Feeders Concealed in Ceilings, Walls, and Partitions: Metal-clad cable, Type MC, or type NM within a single dwelling unit.
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and in Crawlspace: Type THHN-THWN, single conductors in raceway.
- E. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Metal-clad cable, Type MC, or type NM within a single dwelling unit.
- F. Branch Circuits Concealed in Concrete and below Slabs-on-Grade: Type THHN-THWN, single conductors in raceway.
- G. Cord Drops and Portable Appliance Connections: Type SO, hard service cord.
- H. Fire Alarm Circuits: see FIRE ALARM SECTION.

3.2 INSTALLATION

- A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.
- B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- D. Install cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- E. Support cables according to Division 26 Section "Basic Electrical Materials and Methods."
- F. Seal around cables penetrating fire-rated elements according to Division 7 Section "Through-Penetration Firestop Systems."
- G. Identify and color-code conductors and cables according to Division 26 Section "Basic Electrical Materials and Methods."
- H. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.
- I. Where the number of current-carrying conductors in a raceway or cable exceeds three, the allowable ampacity shall be reduced per NEC table based on no diversity. Consider neutrals to be current carrying conductors.

- J. Do not combine neutrals.

3.3 CONNECTIONS

- A. Make all final connections required for a complete and fully operational facility.
- B. Wiring connections to equipment shall include connections to all accessories. For example, if a fan has an associated damper, the wiring must be extended from the fan to the damper at no additional charge. Another example is interconnection of equipment. Some items of equipment consist of several pieces, which must be interconnected before connecting to the circuit. No additional compensation will be paid for interconnections.
- C. 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 486 B.
- D. Avoid splices and taps, where feasible. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- E. Locations of junction boxes, stub-ups and disconnects are diagrammatic. At the time of design, the exact brand of equipment is usually not known. Therefore, the exact locations of connections are not known. For the purposes of bidding assume the worst, farthest locations. During construction, coordinate connections with final approved shop drawings and coordinate with other trades. Conform to manufactures written installation instructions. Provide working space in compliance with code.

3.4 FIELD QUALITY CONTROL

- A. All cables installed under this contract are to be protected from damage prior to installation, during installation and after installation. Store cable in a dry area protected from physical damage. Before installing cable, raceway to be clear, dry and free from burs or sharp edges. When cables pass through metal partitions provide permanently installed insulating bushings. This applies to all cables installed under this contract (systems, communications, etc.). Insulated bushings are to be installed prior to pulling in of cable. Cables to be installed back from edge of studs as required by Code.

END OF SECTION

SECTION 26 0526
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes methods and materials for grounding systems and equipment.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding features specified in Part 3 "Field Quality Control" Article, including the following:
 - 1. Test wells.
 - 2. Ground rods.
 - 3. Ground rings.
 - 4. Grounding for sensitive electronic equipment.
- C. Qualification Data: For testing agency and testing agency's field supervisor.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For grounding to include the following in emergency, operation, and maintenance manuals:
 - 1. Instructions for periodic testing and inspection of grounding features at test wells, ground rings, and grounding connections for separately derived systems, based on NETA MTS.
 - a. Tests shall be to determine if ground resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if they do not.
 - b. Include recommended testing intervals.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

- B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable, insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B 3.
 - 2. Stranded Conductors: ASTM B 8.
 - 3. Tinned Conductors: ASTM B 33.
 - 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.
 - 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 - 6. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
 - 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
- C. Grounding Bus: 6 inch rectangular bars of annealed copper, 1/4 by 2 inches in cross section, unless otherwise indicated; with insulators.

2.2 CONNECTORS

- A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.
 - 1. Pipe Connectors: Clamp type, sized for pipe.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.3 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel, sectional type; 5/8 in diameter by 96 inches (16 by 2400 mm).
- B. Chemical-Enhanced Grounding Electrodes: Copper tube, straight or L-shaped, charged with nonhazardous electrolytic chemical salts.
 - 1. Termination: Factory-attached No. 4/0 AWG bare conductor at least 48 inches (1200 mm) long.
 - 2. Backfill Material: Electrode manufacturer's recommended material.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger, unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 3/0 awg minimum.
 - 1. Bury at least 24 inches (600 mm) below grade.
 - 2. Duct-Bank Grounding Conductor: Bury 12 inches (300 mm) above duct bank when indicated as part of duct-bank installation.
- C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.
- D. Grounding Bus: Install as indicated on plans.
 - 1. Install bus on insulated spacers 1 inch (25 mm), minimum, from wall 6 inches (150 mm) above finished floor, unless otherwise indicated.
- E. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors, except at test wells and as otherwise indicated.
 - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
 - 4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING OVERHEAD LINES

- A. Comply with IEEE C2 grounding requirements.
- B. sistance to ground by a single ground-rod electrode exceeds 25 ohms, install additional ground rods until resistance to ground falls below 25 ohms.
- C. Drive ground rods until tops are 6 inches (150 mm) below finished grade in undisturbed earth.
- D. Ground-Rod Connections: Install Exothermic-welded connections for underground connections and connections to rods.
- E. Lightning Arrester Grounding Conductors: Separate from other grounding conductors.
- F. Secondary Neutral and Transformer Enclosure: Interconnect and connect to grounding conductor.
- G. Protect grounding conductors running on surface of wood poles with molding extended from grade level up to and through communication service and transformer spaces.

3.3 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements.
- B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches (100 mm) will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches (50 mm) above to 6 inches (150 mm) below concrete. Seal floor opening with waterproof, non-shrink grout.
- C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields as recommended by manufacturer of splicing and termination kits.
- D. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches (150 mm) from the foundation.
- E. Transformer pads for utility company transformers: Comply with specifications provided by the utility company.

3.4 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
 - 1. Feeders and branch circuits.
 - 2. Lighting circuits.
 - 3. Receptacle circuits.
 - 4. Single-phase motor and appliance branch circuits.
 - 5. Three-phase motor and appliance branch circuits.
 - 6. Flexible raceway runs.
 - 7. Armored and metal-clad cable runs.
- C. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

3.5 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Common Ground Bonding with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized the same as the system grounding electrode conductor, and install in conduit.
- C. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade, unless otherwise indicated.
 - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.
 - 2. For grounding electrode system, install at least three rods (or ufer and two rods) spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
 - 1. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
 - 2. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.
- E. Grounding and Bonding for Piping:
 - 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 - 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 - 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- F. Ufer Ground (Concrete-Encased Grounding Electrode): Fabricate according to NFPA 70, using a minimum of 20 feet (6 m) of bare copper conductor not smaller than No. 1/0 AWG.
 - 1. If concrete foundation is less than 20 feet (6 m) long, coil excess conductor within base of foundation.
 - 2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building grounding grid or to grounding electrode external to concrete.

3.6 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections and prepare test reports:
1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells, and at individual ground rods. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by fall-of-potential method according to IEEE 81.
 3. Prepare dimensioned drawings locating each test well, ground rod and ground rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- B. Report measured ground resistances that exceed the following values:
1. Power and Lighting Equipment or System with Capacity 500 kVA and Less: 10 ohms.
 2. Power and Lighting Equipment or System with Capacity 500 to 1000 kVA: 5 ohms.
 3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
 4. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 ohms.
 5. Substations and Pad-Mounted Equipment: 5 ohms.
 6. Manhole Grounds: 10 ohms.
- C. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Engineer promptly and include recommendations to reduce ground resistance.

3.7 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Grounding and Bonding: Perform inspections and tests listed in NETA ATS, Section 7.13.
- C. Perform ground resistance testing in accordance with IEEE 142.
- D. Perform leakage current tests in accordance with NFPA 99.
- E. Perform continuity testing in accordance with IEEE 142.
- F. Visually inspect all exothermic connectors. Do not backfill until approved.

END OF SECTION 260526

SECTION 26 0533
RACEWAYS AND BOXES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.
- B. See Division 26 Section "Underground Ducts" for exterior ductbanks, manholes, and underground utility construction.
- C. See Division 7 Section "Through-Penetration Firestop Systems" for firestopping materials and installation at penetrations through walls, ceilings, and other fire-rated elements.
- D. See Division 26 Section "Basic Electrical Materials and Methods" for supports, anchors, and identification products.
- E. See Division 26 Section "Seismic Controls for Electrical Work" for seismic restraints and bracing of raceways, boxes, enclosures, and cabinets.
- F. See Division 26 Section "Wiring Devices" for devices installed in boxes and for floor-box service fittings.

1.2 RELATED DOCUMENTS:

- A. The General Conditions, Supplementary Conditions, and applicable portions of Division 1 of the specification are part of this section which shall consist of all labor, equipment, materials and other costs necessary to complete all **RACEWAYS AND BOXES** work indicated on the drawings, herein specified or both.
- B. The applicable portions of section 260500 BASIC ELECTRICAL MATERIALS AND METHODS are hereby make a part of this section. It is important that you read that section carefully because it expands upon the requirements herein.

1.3 SUBMITTALS

- A. Shop Drawings: Show fabrication and installation details of custom enclosures and cabinets.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

- A. Rigid Steel Conduit: ANSI C80.1.

- B. EMT and Fittings: ANSI C80.3.
 - 1. Fittings: Set-screw or compression, steel. (Die-casts are not acceptable).
- C. FMC: Zinc-coated steel.
- D. LFMC: Flexible steel conduit with PVC jacket.
- E. Fittings: NEMA FB 1; compatible with conduit and tubing materials.

2.2 NONMETALLIC CONDUIT AND TUBING

- A. ENT: NEMA TC 13.
- B. RNC: NEMA TC 2, Schedule 40 and Schedule 80 PVC.
- C. ENT and RNC Fittings: NEMA TC 3; match to conduit or tubing type and material.
- D. LFNC: UL 1660.

2.3 METAL WIREWAYS

- A. Material and Construction: Sheet metal sized and shaped as indicated. Provide NEMA rating to suit environment.
- B. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- C. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.
- D. Wireway Covers: Hinged type, unless otherwise indicated.
- E. Finish: Manufacturer's standard enamel finish.

2.4 SURFACE RACEWAYS

- A. Surface Metal Raceways: Galvanized steel with snap-on covers. Finish with manufacturer's standard prime coating.
- B. Types, sizes, and channels as indicated and required for each application, with fittings that match and mate with raceways.

2.5 BOXES, ENCLOSURES, AND CABINETS

- A. Sheet Metal Outlet and Device Boxes: NEMA OS 1.
- B. Cast-Metal Outlet and Device Boxes: NEMA FB 1, Type FD, with gasketed cover.
- C. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- D. Cast-Metal Pull and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.

- E. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous hinge cover and flush latch.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

2.6 FACTORY FINISHES

- A. Finish: For raceway, enclosure, or cabinet components, provide manufacturer's standard prime-coat finish ready for field painting.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors:

- 1. Exposed: Rigid steel. (Note: All raceways to be concealed unless otherwise indicated.)
- 2. Concealed: Rigid steel.
- 3. Underground, Single Run: RNC.
- 4. Underground, Grouped: RNC.
- 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
- 6. Boxes and Enclosures: NEMA 250.

B. Indoors:

- 1. Exposed: EMT. (Note: all raceways to be concealed unless otherwise indicated).
- 2. Concealed: EMT.
- 3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC; except use LFMC in damp or wet locations.
- 4. Damp or Wet Locations: Rigid steel conduit.
- 5. Boxes and Enclosures: NEMA 250, Type 1, except as follows:
 - a. Damp or Wet Locations: NEMA 250, Type 4.

C. Minimum Raceway Size: ½-inch trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

3.2 INSTALLATION

- A. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- B. Complete raceway installation before starting conductor installation.
- C. Support raceways as specified in Division 26 Section "Basic Electrical Materials and Methods."
- D. Install temporary closures to prevent foreign matter from entering raceways.

- E. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portions of bends are not visible above finished slab.
- F. Make bends and offsets so ID is not reduced. Keep legs of bends in same plane and keep straight legs of offsets parallel, unless otherwise indicated.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
 - 1. Install concealed raceways with a minimum of bends in shortest practical distance, considering type of building construction and obstructions, unless otherwise indicated.
- H. Raceways Embedded in Slabs: Install in middle 1/3 of slab thickness where practical and leave at least 2 inches (50 mm) of concrete cover.
 - 1. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
 - 2. Space raceways laterally to prevent voids in concrete.
 - 3. Run conduit larger than 1-inch trade size (DN 27) parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
 - 4. Change from nonmetallic tubing to rigid steel conduit before rising above floor.
 - 5. Do not run raceways in “topping” of precast concrete.
- I. Install exposed raceways parallel or at right angles to nearby surfaces or structural members and follow surface contours as much as possible.
 - 1. Run parallel or banked raceways together on common supports.
 - 2. Make parallel bends in parallel or banked runs. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.
- J. Join raceways with fittings designed and approved for that purpose and make joints tight.
 - 1. Use insulating bushings to protect conductors.
- K. Tighten set screws of threadless fittings with suitable tools.
- L. Terminations:
 - 1. Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against box. Use two locknuts, one inside and one outside box.
 - 2. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into hub so end bears against wire protection shoulder. Where chase nipples are used, align raceways so coupling is square to box; tighten chase nipple so no threads are exposed.
- M. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire.
- N. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with UL-listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 2. Where otherwise required by NFPA 70.
- O. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with finished floor. Extend conductors to equipment with rigid steel conduit; FMC may be used 6 inches (150 mm) above the floor. Install screwdriver-operated, threaded plugs flush with floor for future equipment connections.
- P. Flexible Connections: Use maximum of 72 inches (1830 mm) of flexible conduit for recessed and semi-recessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for all motors. Use LFMC in damp or wet locations. Install separate ground conductor in flexible conduit and in LFMC.
- Q. Surface Raceways: Install a separate, green, ground conductor in raceways from junction box supplying raceways to receptacle or fixture ground terminals.
- R. Install hinged-cover enclosures and cabinets plumb. Support at each corner.
- S. Provide a minimum of 2-inch spacing between raceways underground or in concrete.
- T. Provide a minimum of 2-inches of concrete encasement on PVC underground.
- U. Provide a minimum of 2-iches of concrete encasement on all underground “primary” raceways (metal and non-metallic), above 600 volts.
- V. Provide colored electrical marker warning tape above all buried raceways and cables including those that are concrete encased. For non-metallic raceways or direct burial cables, use marker tape with foil back. Locate a minimum of 12 inches above raceway, cable or concrete.
- W. Expansion fittings shall be provided in all raceways, if and where required.

3.3 PROTECTION

- A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION

SECTION 26 0543
UNDERGROUND DUCTS

PART 1 – GENERAL

1.1 SUMMARY

A. Scope of Specification

1. This Section includes underground conduits, ducts and duct banks.

B. Related Specifications

1. Drawing and general provisions of the Contract, including general and Supplementary Conditions and Division 1 Specifications Sections, apply to this Section.
2. Related Sections: The following Sections contain requirements that relate to this Section:
 - a Division 31 Section for general requirements for excavation, backfill and related items for ducts.

C. Definitions

1. Duct: Electrical conduit and other raceway, either metallic or nonmetallic, used underground, embedded in earth or concrete.
2. Duct Bank: 2 or more conduits or other raceway installed underground in the same trench or concrete envelope.

D. Applicable Standards

1. NFPA 70 – “National Electric Code”
2. UL 1990 – “Underground Conduit, Non Metallic”
3. Conduit Standards listing in Section 2.2

E. Submittals

1. General: Submit the following according to Conditions of the Contract and Division 1 Specification Sections.
2. Product data for metal accessories for manholes and handholes, conduit and duct, duct bank materials, and miscellaneous components.
3. Shop drawings showing details and design calculations for precast manholes and handholes, including reinforcing steel. Stamp drawings with seal of registered professional structural engineer.
4. Certificate for concrete and steel used in underground precast concrete utility structures, according to ASTM C 858.
5. Inspection report for factory inspections, according to ASTM C 1037.
6. Coordination drawings showing duct profiles and coordination with other utilities and underground structures. Include plans and sections drawn to accurate scale.
7. Qualification data for firms and persons specified in “Quality Assurance” Article to demonstrate their capabilities and experience. Include list of completed projects with project names, addresses, names of Architect and Owner, and other information specified.
8. Field test reports indicating and interpreting test results relative to compliance with performance requirements of “Field Quality Control” Article in Part 3 of this Section.

9. Record Documents: Show dimensioned locations of underground ducts, handholes, and manholes.

F. Quality Assurance

1. Manufacturer Qualifications: Firm experienced in manufacturing underground precast concrete utility structures of types and sizes required and similar to those indicated for this project. Firm must have a record of successful in-service performance.
2. Comply with NFPA 70 “National Electrical Code” and ANSI C2 “National Electrical Safety Code” for components and installation.
3. Listing and Labeling: Provide products specified in this Section that are listed and labeled.
 - a The Terms “Listed” and “Labeled”: As defined in the “National Electrical Code,” Article 100.
 - b Listing and Labeling Agency Qualifications: A “Nationally Recognized Testing Laboratory” (NRTL) as defined in OSHA Regulation 1910.7.
4. Coordinate layout and installation of ducts with final arrangement of other utilities and determined in the field.

G. Delivery, Storage and Handling

1. Deliver ducts to site with ends capped. Store nonmetallic ducts with supports to prevent bending, warping, and deforming.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering the specified products that may be incorporated in the Work include, but are not limited to the following:

1. Nonmetallic Ducts:
 - a Arnco Corp.
 - b Breeze-Illinois, Inc.
 - c CANTEX, Inc.
 - d Carlon; Lamson & Sessions Company
 - e Pipe & Plastic Group; Certainteed Products Corp.
 - f Cole-Flex Corp.
 - g Electri-Flex Co.
 - h Spiraduct, Inc.

2.2 CONDUIT AND DUCT

- A. Rigid Steel Conduit: ANSI C80.1, galvanized.
- B. Rigid Plastic Conduit: NEMA TC 2, Schedule 40 PVC, rated for use with 90 deg. C conductors under all installation conditions.
- C. PVC Conduit and Tubing Fittings: NEMA TC 3.

- D. Rigid Plastic Underground Conduit: UL 651A, Type A PVC.
- E. Rigid Plastic Underground Conduit: UL 651A, Type EB PVC.
- F. Rigid Plastic Underground Conduit: High-density polyethylene, Schedule 40.
- G. Rigid Plastic Underground Conduit: Fiberglass-reinforced epoxy.
- H. Plastic Utilities Duct: NEMA TC 6.
- I. Plastic Utilities Duct Fittings: NEMA TC 9; match to duct type and material.
- J. Plastic Communication Duct and Fittings: NEMA TC 10.
- K. Manufactured Bends: Not less than 36-inch (900 mm) radius.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Underground Ducts For Electrical Utility Service primary: Plastic conduit encased in “Red” concrete.
- B. Underground Ducts For Electrical Feeders: Plastic conduit encased in “Red” concrete where under driveway or road.

3.2 EXAMINATION

- A. Examine site to receive ducts for compliance with installation tolerances and other conditions affecting performance of the underground ducts. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.3 EARTHWORK

- A. Excavation and Backfill: Conform to Division 2 Section “Earthwork,” but do not use heavy-duty, hydraulic-operated compaction equipment.
- B. Restore surface features at areas disturbed by excavation, and reestablish original grades except as otherwise indicated. Replace removed sod as soon as possible after backfilling is complete. Restore all areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, or mulching. Perform according to Division 2 Section “Landscape Work.”
- C. Restore disturbed paving. Refer to “Cutting and Patching” in Division 1.

3.4 CONDUIT AND DUCT INSTALLATION

- A. Install nonmetallic conduit and duct as indicated according to manufacturer’s written instructions.
- B. Slope: Pitch ducts minimum of 4 inches per 100 feet (1:300) to drain toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between 2 manholes to drain in both directions.

- C. Curves and Bends: Use manufactured elbows for stub-ups at equipment and at building entrances. Use manufactured long sweep bends with a minimum radius of 25 feet (7.5 m) both horizontally and vertically at other locations.
- D. Make joints in ducts and fittings watertight according to manufacturer's instructions. Stagger couplings so those of adjacent ducts do not lie in the same plane.
- E. Building Entrances: Transition for underground duct to schedule 80 conduit 10 feet (3 m) minimum outside the building wall. Use fittings manufactured for the purpose. Follow appropriate installation instructions below. Provide expansion joint above grade.
- F. Concrete-Encased Ducts: Install reinforcing in duct banks passing through disturbed earth near buildings and other excavations. Coordinate duct bank with structural design to support duct bank at wall without reducing structural or watertight integrity of building wall.
- G. Direct-Buried, Nonencased Duct Entering Nonwaterproofed Walls: Install a Schedule 40 galvanized-steel pipe sleeve for each duct. Caulk space between conduit and sleeve with duct-sealing compound on both sides for moisture-tight seal.
- H. Waterproofed Wall and Floor Entrances: Install a watertight entrance-sealing device with the sealing gland assembly on the inside. Anchor device into masonry construction with 1 or more integral flanges. Secure membrane waterproofing to the device to make permanently watertight.
- I. Separation Between Direct-Buried, Nonencased Ducts: 3 inches (75 mm) minimum for like services, and 12 inches (300 mm) minimum between power and signal ducts.
- J. Concrete-Encased Nonmetallic Ducts: Support on plastic separators coordinated with duct size and required duct spacing, and install according to the following:
- K. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts, and secure separators to the earth and to ducts to prevent floating during concreting. Do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
- L. Concreting: Spade concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not use power-driven agitating equipment unless specifically designed for duct bank application. Pour each run of envelope between manholes or other terminations in 1 continuous operation. When more than one pour is necessary, terminate each pour in a vertical plane and install $\frac{3}{4}$ -inch (18 mm) reinforcing rod dowels extending 18 inches (450 mm) into the concrete on both sides of joint near the corners of the envelope.
- M. Reinforcing: Reinforce duct banks where they cross disturbed earth and where indicated.
- N. Forms: All ductbanks shall be formed. Use of the walls of the trench to form the side walls of the duct bank is unacceptable.
- O. Minimum Clearances Between Ducts: 3 inches (75 mm) between ducts and exterior envelope wall and for like services, and 10 inches (250 mm) between power and signal ducts.
- P. Depth: Except as otherwise indicated, install top of duct bank at least 24 inches (600 mm) below finished grade in non-traffic areas and at least 30 inches (750 mm) below finished grade in vehicular traffic areas.

- Q. Stub-Ups: Use rigid steel conduit or stub-ups to equipment. For equipment mounted on outdoor concrete pads, extend steel conduit a minimum of 5 feet (1.5 m) from edge of pad. Install insulated grounding bushings on the terminations. Couple steel conduits to the ducts with adapters designed for the purpose and then encase coupling with 3 inches (75 mm) of concrete.
- R. Sealing: Provide temporary closure at terminations of ducts that are wired under this Project. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15 psi (1.03 Mpa) hydrostatic pressure.
- S. Pulling Cord: Install 100-pound-test nylon cord in ducts, including spares.
- T. Provide a plastic warning tape 12" below finish grade above the duct or duct bank.

3.5 FIELD QUALITY CONTROL

- A. Testing: Demonstrate capability and compliance with requirements upon completion of installation of underground duct.
- B. Duct Integrity: Rod ducts with a mandrel $\frac{1}{4}$ inch (6 mm) smaller in diameter than internal diameter of ducts. Where rodding indicated obstructions in ducts, remove the obstructions and retest.
- C. Water Tightness: Make internal inspection of manholes 3 months after completion of construction for indications of water ingress. Where leakage is noted, remove water and seal leak sources. Re-inspect after 2 months and reseal remaining leak sources. Repeat process at 2 month intervals until leaks are corrected.
- D. Correct installation where possible, and retest to demonstrate compliance. Otherwise, remove and replace defective products and retest.

3.6 CLEANING

- A. Pull brush through full length of ducts. Use round bristle brush with a diameter $\frac{1}{2}$ inch (12 mm) greater than internal diameter of duct.

END OF SECTION

SECTION 262150

WIRING CONNECTIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes electrical connections to equipment.
- B. See Section 260519 Conductors and Cables.

PART 2 - PRODUCTS

2.1 SPLICES AND TAPS

- A. Splices, taps, and terminations in wiring #6 AWG and larger shall be made with color keyed compression type solderless pressure connectors designed for the purpose. The splices and taps shall be taped to provide insulation not less than that of the conductor.
- B. All joints between wires and fixtures shall be made with spring type connectors. *Push-in type connectors are not allowed.*
- C. Wire connectors shall be taped with plastic tape of same color as conductor after installation.

END OF SECTION

SECTION 26 2416
PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes distribution panelboards and lighting and appliance branch-circuit panelboards.

1.2 RELATED DOCUMENTS:

- A. The General Conditions, Supplementary Conditions, and applicable portions of Division 1 of the specification are part of this section which shall consist of all labor, equipment, materials and other costs necessary to complete all PANELBOARDS work indicated on the drawings, herein specified or both.
- B. The applicable portions of section 260500 BASIC ELECTRICAL MATERIALS AND METHODS are hereby make a part of this section. It is important that you read that section carefully because it expands upon the requirements herein.

1.3 SUBMITTALS

- A. Product Data: For each type of panelboard, overcurrent protective device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings. Include the following:
 - a. Enclosure types and details for types other than NEMA 250, Type 1.
 - b. Short-circuit current rating of panelboards and overcurrent protective devices.
 - c. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 2. Wiring Diagrams: Power, signal, and control wiring.
 - 3. Field quality-control test reports.
 - 4. Operation and maintenance data.
- C. When used as "service Entrance Equipment", it is the Contractor's responsibility to submit all shop drawings to the local power company and electrical inspector and obtain their approval (including main circuit breakers characteristics) prior to fabrication.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NEMA PB 1.
- C. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Panelboards, Overcurrent Protective Devices, Controllers, Contactors, and Accessories:
 - a. Square D
 - b. Eaton Corporation; Cutler Hammer Products.
 - c. General Electric
 - d. Siemens Energy and Automation, Inc.
 - e. Approved equal.

2.2 MANUFACTURED UNITS

- A. Enclosures: NEMA PB 1, Type 1.
 - 1. Rated for environmental conditions at installed location.
 - a. Outdoor Locations: NEMA 250, Type 3R.
 - b. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
 - c. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
 - d. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7C.
 - 2. Door-In-Trim: Provide with piano hinge on left side of trim, so that trim (and door) can be swung open for easy access to wiring terminals (rather than removed).
 - 3. Equip door with spring latch and tumbler-lock with all locks keyed alike.
- B. Phase and Ground Buses: Copper.
- C. Conductor Connectors: Suitable for use with conductor material.
- D. Service Equipment Label: UL labeled for use as service equipment for panelboards with main service disconnect breakers.
- E. Future Devices: Mounting brackets, bus connections, and necessary appurtenances required for future installation of devices.
- F. Panelboard Short-Circuit Rating:
 - 1. Fully rated to interrupt symmetrical short-circuit current available at terminals.
 - 2. Unless otherwise indicated, a “series-combination system” of interrupting capacity rating shall not be used.
- G. Service Entrance Equipment: When used as service entrance equipment, so rate.
- H. Provide typed circuit directory card mounted in frame with clear plastic covering.

2.3 DISTRIBUTION PANELBOARDS

- A. Doors: Secured with vault-type latch with tumbler lock; keyed alike. Omit for fused-switch panelboards. See 2.2A2
- B. Main Overcurrent Protective Devices: Bolt-on, circuit breakers.
- C. Branch Overcurrent Protective Devices: Bolt-on, full size, circuit breakers.

2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Branch Overcurrent Protective Devices: Bolt-on full size circuit breakers, replaceable without disturbing adjacent units.
- B. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike. See 2.2A2

2.5 OVERCURRENT PROTECTIVE DEVICES

- A. Provide circuit breakers, per Section 262816 "Enclosed switches and circuit breakers".

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install panelboards and accessories according to NEMA PB 1.1.
- B. Mount top of trim 74 inches (1880 mm) above finished floor, unless otherwise indicated.
- C. Mount plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish.
 - 1. Set field-adjustable and circuit-breaker trip ranges.
- D. Install filler plates in unused spaces.
- E. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Basic Electrical Materials and Methods".
- F. Panelboard Nameplates: Label each panelboard with engraved laminated-plastic nameplate mounted with corrosion-resistant screws. Confirm naming criteria with Owner.
- G. Connect wiring according to Division 26 Section "Conductors and Cables."
- H. Re-Torque: Once in final location, carefully re-torque all connections with a torque wrench, to match manufacturer's recommendations. If equipment is dismantled, it must be re-inspected and re-certified by a nationally recognized testing laboratory, acceptable to the Engineer and the Authority Having Jurisdiction.
- I. Aluminum Cable Connections: If aluminum wire is permitted in Division 16, section "Conductors and Cables", circumferential compression type lugs are required for all terminations on aluminum wire. Where screw type lugs are used, it will be necessary to convert from aluminum to copper wiring before connection. This can be done by use of T & B or similar cast, compression connectors. Adequate wiring space must be provided for connectors, if used.

3.2 CIRCUIT BREAKER ADJUSTMENTS

- A. Adjust as described in section 262816 “Enclosed Switches and Circuit Breakers”.

3.3 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- B. Perform the following inspections:
 - 1. Perform each visual and mechanical inspection stated in NETA ATS, section 7.6.
- C. Perform the following field tests and inspections and prepare test reports:
 - 1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

END OF SECTION

SECTION 26 2419
HVAC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes:

1. Electrical work relating to the work of Division 23 "MECHANICAL".
2. Power Monitors: To disconnect power to motors, in the event of abnormal power conditions.

1.2 RELATED DOCUMENTS:

- A. The General Conditions, Supplementary Conditions, and applicable portions of Division 1 of the specification are part of this section which shall consist of all labor, equipment, materials and other costs necessary to complete all **HVAC ELECTRICAL REQUIREMENTS** work indicated on the drawings, herein specified or both.
- B. The applicable portions of section 260500 BASIC ELECTRICAL MATERIALS AND METHODS are hereby make a part of this section. It is important that you read that section carefully because it expands upon the requirements herein.

1.3 SUBMITTALS

- A. Product Data: For each product indicated.
- B. Shop Drawings: Wiring and connection diagrams.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 HVAC & PLUMBING

- A. Provide all wire, conduit, boxes and fittings for all HVAC and plumbing equipment and final connections. Conform to Division 26, Section "Conductors and Cables".
- B. Examine DIVISION 23 carefully for any work specified as performed under this Section and coordinate.
- C. Provide all disconnects according to Division 26, Section "Enclosed Switches and Circuit Breakers".
- D. Provide nameplates on all disconnects according to Division 26, Section "Basic Materials and Methods".
- E. Automatic starters and manual starters (thermal toggle switches) to be furnished under DIVISION 23 and installed and wired (both sides) under this Section. Some starters may

be variable frequency drive (VFD) type and may have built-in disconnects. Provide wiring on both sides. Some VFD's are large and heavy. Provide adequate mounting support and proper working space.

- F. Provide a manual starter (thermal toggle switch) at each motor not furnished with an automatic starter. Manual starters shall consist of a manual operated toggle switch equipped with a melting alloy type thermal overload relay. Starters must be inoperative if thermal unit is removed. Mount at motor location.
- G. Temperature controls are provided under DIVISION 23. Temperature control wiring, interlock wiring, and boiler control wiring are provided under DIVISION 23, except as shown on the electrical drawings or indicated differently herein.
- H. Provide "Fire-O-Matic" detector, remote shut-off, and associated wiring for each boiler/furnace/water heater.
- I. Install and wire to electric heating units furnished under DIVISION 23.
- J. Provide power wiring to all control transformers and temperature control panels.
- K. Control valves and transformers for all heating units are furnished and installed under DIVISION 23.
- L. Do not use electrical drawings for location of feeds to mechanical equipment. In general, use mechanical drawings for bidding purposes and final approved mechanical shop drawings for actual installation. However, report any discrepancies to mechanical and electrical engineer for final determination, prior to installation.

2.2 MAGNETIC STARTERS

- A. General Requirements: Provide across-the-line magnetic type starters rated in accordance with NEMA standards, sizes, and horsepower ratings, where indicated on the drawings. Provide enclosures NEMA and UL rated for the environment. Unless otherwise indicated, as a minimum provide NEMA 1 (general purpose) indoors and NEMA 4 (watertight) in damp locations and outdoors.
- B. Manufacturers: Provide starters as manufactured by Square "D", General Electric, Cutler-Hammer, or Siemens.
- C. Contacts: Provide double break silver alloy contacts. Construct such that contacts are replaceable without removing power wiring or removing starters from the panel. Provide straight-through wiring.
- D. Overload Relays and Thermal Units: Provide melting alloy type overload relays with a replaceable control circuit. Construct thermal units of one-piece design and make interchangeable. Make starter inoperative if the thermal unit is removed.
- E. Coils: Provide coils of molded construction. Construct such that coils are replaceable from the front without removing the starter from the panel.
- F. Auxiliary Contacts: Make starters suitable for the addition of up to three external auxiliary contacts of any arrangement (normally open or normally closed). Provide auxiliary contacts necessary to perform all intended functions.
- G. Special Features: Provide the following special features as indicated on the electrical or mechanical drawings or specifications:

HAND-OFF-AUTO	Provide three-position H-O-A switch in cover.
START-STOP	Provide start-stop momentary push buttons in cover.
PILOT LIGHT	Provide pilot light in cover of enclosure.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install according to NEMA standards.
- B. Mount plumb and rigid without distortion of box.
- C. Provide supports and nameplates, according to Division 26 section "Basic Electrical Materials and Methods".
- D. Provide wiring according to Division 26, Section "Conductors and Cables".
- E. Provide raceways according to Division 26, Section "Raceways and Boxes".

END OF SECTION

SECTION 26 2726
WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
1. Single and duplex receptacles, ground-fault circuit interrupters, and integral surge suppression units.
 2. Snap switches and dimmer switches.
 3. Device wall plates.
 4. Emergency lighting relays.

1.2 RELATED DOCUMENTS:

- A. The General Conditions, Supplementary Conditions, and applicable portions of Division 1 of the specification are part of this section which shall consist of all labor, equipment, materials and other costs necessary to complete all **WIRING DEVICES** work indicated on the drawings, herein specified or both.
- B. The applicable portions of section 260500 BASIC ELECTRICAL MATERIALS AND METHODS are hereby make a part of this section. It is important that you read that section carefully because it expands upon the requirements herein.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: Upon request.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Wiring Devices:
 - a. General Electric Company: Wiring Device Division
 - b. Bryant Electric, Inc./Hubbell Subsidiary.
 - c. Hubbell Incorporated; Wiring Device-Kellems.
 - d. Leviton Mfg. Company Inc.
 - e. Pass & Seymour/LeGrand; Wiring Devices Div.

2. Multioutlet Assemblies:
 - a. Hubbell Incorporated; Wiring Device-Kellems.
 - b. Wiremold Company (The).

2.2 RECEPTACLES

- A. Provide 20 amp. commercial specification grade, grounded, duplex receptacles. Color as selected by Architect. Provide additional receptacles to suit the particular equipment served. Catalog numbers are for General Electric Company.

20A/125V	Duplex Receptacle	GE #GCR-20
20A/125V	Single Receptacle	GE #4102
30A/125V/250V	4 Wire Receptacle	GE #1439-3
50A/125V/250V	4 Wire Receptacle	GE #4181-3
20A/125V	Duplex Receptacle	GE #5362-IG (Isolated Ground)
20A/125V	Single Receptacle	GE #4102-IG (Isolated Ground)
20A/125V	GFI Dup. Rec.	GE #GFR 5342

1. Provide other special duty receptacles as indicated on the drawings.
2. Receptacles mounted outdoors or in other wet or damp locations shall be GFI type and installed in weatherproof enclosures with key lock cover, the integrity of which is not affected when the receptacle is in use (attachment plug cap inserted).

2.3 SWITCHES

- A. Provide 20 amp. rocker type, "Federal Specification Grade" lighting switches. Color as selected by Architect.

2.4 WALL PLATES

- A. Single and combination types to match corresponding wiring devices.
 1. Plate-Securing Screws: Metal with head color to match plate finish.
 2. Receptacles mounted outdoors or in other wet or damp locations shall be installed in weatherproof enclosures with key lock cover, the integrity of which is not affected when the receptacle is in use (attachment plug cap inserted).
 3. Provide stainless steel receptacle cover plates with brushed finish. (Type 302).
 4. Confirm trim material and color with Architect.

2.5 EMERGENCY LIGHTING RELAYS

- A. Provide relays in emergency lighting circuits to cause emergency lights to automatically light whenever the emergency transfer switch goes to the emergency position, regardless of the position of the local switch.
- B. Provide SPDT transfer relays in NEMA #1 enclosure above accessible suspended ceiling or flush mounted adjacent to lighting panel. Provide one relay for each switch. Provide holding coils rated for continuous operation with 24 ampere contacts. Wire as indicated on the drawings or as directed.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install devices and assemblies level, plumb, and square with building lines.
- B. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical. Group adjacent switches under single, multigang wall plates.
- C. Remove wall plates and protect devices and assemblies during painting.

3.2 IDENTIFICATION

- A. Comply with Division 26 Section "Basic Electrical Materials and Methods."
 - 1. Receptacles: Engrave each receptacle plate with panel designation and circuit number. (Brother P-Touch Labeling System is acceptable, in lieu of engraving.)
 - 2. Outlet boxes: Provide cardboard tags, tied to each wire inside all outlet boxes (receptacles, switches, motors, etc). Include panel designation and circuit number.

3.3 CONNECTIONS

- A. Ground equipment according to Division 26 Section "Grounding and Bonding."
- B. Connect wiring according to Division 26 Section "Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections:
 - 1. After installing wiring devices and after electrical circuitry has been energized, test for proper polarity, ground continuity, and compliance with requirements.
 - 2. Test GFCI operation with both local and remote fault simulations according to manufacturer's written instructions.
- B. Remove malfunctioning units, replace with new units, and retest as specified above.

END OF SECTION

SECTION 26 2813

FUSES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Cartridge fuses rated 600 V and less.

1.2 RELATED DOCUMENTS:

- A. The General Conditions, Supplementary Conditions, and applicable portions of Division 1 of the specification are part of this section which shall consist of all labor, equipment, materials and other costs necessary to complete all **FUSES** work indicated on the drawings, herein specified or both.
- B. The applicable portions of section 260500 BASIC ELECTRICAL MATERIALS AND METHODS are hereby make a part of this section. It is important that you read that section carefully because it expands upon the requirements herein.

1.3 SUBMITTALS

- A. Product Data: For each fuse type indicated.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NEMA FU 1.
- C. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Cooper Bussman, Inc.
 - 2. Tracor, Inc.; Littlefuse, Inc. Subsidiary.
 - 3. Gould

2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, nonrenewable cartridge fuse; class and current rating indicated; voltage rating consistent with circuit voltage.

2.3 SPARE FUSE CABINET

- A. Cabinet: suitably identified, wall-mounted, lockable, compartmented steel cabinet, sized to hold spare fuses specified.
- B. Mount where directed.

PART 3 - EXECUTION

3.1 FUSE APPLICATIONS

- A. Provide all main, switchboard, and distribution panel fuses Class L, Class J, or Class RK1 current limiting time delay type. At other locations, provide Class J or Class RK1 dual-element, time-delay type fuses. "One-time", "renewable" and RK5 type fuses are not acceptable.
- B. Provide one spare set (3) of each size and type used. Where fuse sizes are not indicated, size per N.E.C.

FUSE CLASS	LITTLEFUSE	BUSSMANN	GOULD
L	KLPC	KRPC	A4BQ
J	JTD	LPJ	AJT
RK-1	LLSRK/LLNRK	LPSRK/LPNRK	A6D/A2D

3.2 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

3.3 IDENTIFICATION

- A. Install labels indicating fuse replacement information on inside door of each fused switch.

END OF SECTION

SECTION 26 2816
ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following individually mounted, enclosed switches and circuit breakers:
 - 1. Fusible switches.
 - 2. Molded-case circuit breakers.
 - 3. Solid state circuit breakers
 - 4. Enclosures.

1.2 RELATED DOCUMENTS:

- A. The General Conditions, Supplementary Conditions, and applicable portions of Division 1 of the specification are part of this section which shall consist of all labor, equipment, materials and other costs necessary to complete all **ENCLOSED SWITCHES AND CIRCUIT BREAKERS** work indicated on the drawings, herein specified or both.
- B. The applicable portions of section 260500 BASIC ELECTRICAL MATERIALS AND METHODS are hereby make a part of this section. It is important that you read that section carefully because it expands upon the requirements herein.

1.3 SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 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 FUSIBLE SWITCHES

- A. Manufacturers:
 - 1. Square D
 - 2. General Electric
 - 3. Siemens Energy and Automation, Inc.
 - 4. Eaton Corporation; Cutler Hammer Products

- B. All fusible switches: shall be rated for the application voltage specified and have a UL listed short circuit rating to match the fuse installed. Provide heavy duty switches. General duty switches are unacceptable.
- C. Fusible Switch, 600 A and Smaller: NEMA KS 1, Type HD, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.
- D. Fusible switches, 800 amps and above: NEMA bolted pressure contact switches made by firmly bolting the switchblades to the stationary contact terminals and to the hinge terminals and meet UL 977.
- E. Accessories:
 - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded, and bonded; and labeled for copper and aluminum neutral conductors. (Provide when neutral is available at switch).

2.3 MOLDED-CASE CIRCUIT BREAKERS

- A. Manufacturers: Eaton Corporation; Cutler-Hammer Products. NO SUBSTITUTIONS ALLOWED.
- B. Interrupting Capacity: Unless otherwise indicated, a “series-combination” system of interrupting capacity rating shall not be used.
- C. Switching Duty: All single pole circuit breakers to be rated SWD.
- D. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents. All main breakers to be 100% rated.
 - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger. Adjust as prescribed in 3.2.
 - 2. Current-Limiting Circuit Breakers: Where needed.
 - 3. GFCI Circuit Breakers: Single- and two-pole configurations with 5-mA trip sensitivity for personnel protection and 30-mA trip for equipment protection.
- E. Molded-Case Circuit-Breaker Features and Accessories:
 - 1. Standard frame sizes, trip ratings, and number of poles.
 - 2. Lugs: Mechanical style suitable for number, size, trip ratings, and conductor material.
 - 3. Application Listing: Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
 - 4. Ground-Fault Protection: With adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator. Provide ground-fault protection when indicated or where required by code.
 - 5. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage. Provide shunt trip when indicated.
- F. Electronic trip-unit circuit breakers: where indicated or required, 100% rated, with RMS sensing, field-replaceable rating plug, trip indication (showing which adjustment caused

trip) and the following field-adjustable settings, with interrupting capacity to meet available fault current.

1. Instantaneous trip
2. Long-time pickup
3. Short-time pickup
4. Long-time delay
5. Short-time delay
6. Ground fault (if required)

2.4 ENCLOSURES

A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.

1. Outdoor Locations: NEMA 250, Type 3R.
2. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
3. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with applicable portions of NECA 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed switches and circuit breakers.
- B. Mount individual wall-mounting switches and circuit breakers with tops at uniform height, unless otherwise indicated. Anchor floor-mounting switches to concrete base.
- C. Comply with mounting and anchoring requirements specified in Division 26 Section "Seismic Controls for Electrical Work."
- D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- E. Most manufactures of bolted pressure switches make for line entering top and load exiting bottom. Verify shop drawings before running conduits.
- F. Do not mount switches or circuit breakers upside down or side ways.
- G. Identify field-installed conductors, interconnecting wiring, and components; provide labels and warning signs as specified in Division 16 Section "Basic Electrical Materials and Methods."

3.2 CIRCUIT BREAKER ADJUSTMENTS

A. Thermal-magnetic circuit breakers:

1. Test circuit and correct deficiencies
2. Set magnetic trip at minimum.
3. Turn associated loads "on".
4. Turn breaker on/off a minimum of six (6) times.
5. If nuisance tripping occurs, set "up" one notch and repeat test.
6. Repeat steps 4 and 5 until nuisance tripping no longer occurs.

B. Electronic trip-unit circuit breakers:

1. Test circuit and correct deficiencies.

2. Set “long time pickup” at 1.0 (Do not change)
3. Set other adjustments at minimum.
4. Turn associated loads “on”.
5. Turn breaker on/off a minimum of six (6) times.
6. If nuisance tripping occurs, adjust setting that caused trip “up” one notch and repeat test.
7. Repeat steps 5 and 6 until nuisance tripping no longer occurs.

3.3 FIELD QUALITY CONTROL

A. Prepare for acceptance testing as follows:

1. Inspect mechanical and electrical connections.
2. Verify switch and relay type and labeling verification.
3. Verify rating of installed fuses.

B. Perform the following field tests and inspections.

1. Perform visual and mechanical inspection stated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

END OF SECTION

SECTION 26 5100
INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Interior lighting fixtures with lamps and ballasts.
2. Lighting fixtures mounted on exterior building surfaces with lamps and ballasts.
3. Accessories, plaster rings, fasteners, etc.
4. Lamps in equipment (regardless of which specification Division that the equipment is supplied under). This includes lamps in fan/light combinations, heat lamps, lamps in medicine cabinets, etc.

1.2 RELATED DOCUMENTS:

- A. The General Conditions, Supplementary Conditions, and applicable portions of Division 1 of the specification are part of this section which shall consist of all labor, equipment, materials and other costs necessary to complete all **INTERIOR LIGHTING** work indicated on the drawings, herein specified or both.
- B. The applicable portions of section 260500 BASIC ELECTRICAL MATERIALS AND METHODS are hereby make a part of this section. It is important that you read that section carefully because it expands upon the requirements herein.

1.3 SUBMITTALS

- A. Product Data: For each type of lighting fixture scheduled, arranged in order of fixture designation. Include data on features, accessories, and finishes.
- B. Shop Drawings: Show details of nonstandard or custom fixtures. Indicate dimensions, weights, methods of field assembly, components, features, and accessories.
- C. Operation and maintenance data.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.
- C. FMG Compliance: Fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FMG.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.

2.2 LIGHTING FIXTURES

- A. See schedules on drawings.

2.3 FLUORESCENT LAMP BALLASTS

- A. Description: Include the following features, unless otherwise indicated:

1. Designed for type and quantity of lamps indicated at full light output.
2. Provide Class P, self protected ballasts.
3. Subject to compliance with requirements, manufacturers offering products include but are not limited to the following: Advance, Osram Sylvania, General Electric, Magnetek, Motorola or Lutron.
4. Ballasts must be CBM and ETL certified and meet NEC and UL requirements.
5. "Packaged Prices" for lighting fixtures are prohibited. See section 260500 – Basic Electrical Materials and Methods.

- B. Electronic ballasts for linear lamps shall include the following features, unless otherwise indicated:

1. Comply with NEMA C82.11.
2. Ballast Type: Instant start, unless otherwise indicated.
3. Sound Rating: A.
4. Total harmonic distortion rating of less than 20 percent according to NEMA C82.11.
5. Transient Voltage Protection: IEEE C62.41, Category A.
6. Operating Frequency: 20 kHz or higher.
7. Lamp Current Crest Factor: Less than 1.7.
8. Parallel Lamp Circuits: Multiple lamp ballasts connected to maintain full light output on surviving lamps if one or more lamps fail.
9. Low Power: Provide low power ballasts for code 30 and code 32 power company rebate features.

- C. Electromagnetic ballasts for linear lamps shall have the following features, unless otherwise indicated:

1. Comply with NEMA C82.1.
2. Type: Energy-saving, high power factor, Class P, automatic-reset thermal protection.
3. Ballast Manufacturer Certification: Indicated by label.
4. Provide lamp end-of-life detection and shutdown circuit for T5 diameter lamps.

- D. Ballasts for compact lamps in recessed fixtures shall have the following features, unless otherwise indicated:

1. Type: Electronic or electromagnetic, as indicated.
2. Power Factor: 90 percent, minimum.
3. Flicker: Less than 5 percent.
4. Lamp Current Crest Factor: Less than 1.7.
5. Electronic Ballast Operating Frequency: 20 kHz or higher.
6. Lamp end-of-life detection and shutdown circuit for electronic ballasts.
7. Transient Protection: Comply with IEEE C62.41 for Category A1 locations.

- E. Ballasts for compact lamps in nonrecessed fixtures shall include the following features, unless otherwise indicated:
 - 1. Power Factor: 90 percent, minimum.
 - 2. Ballast Coil Temperature: 65 deg C, maximum.
 - 3. Transient Protection: Comply with IEEE C62.41 for Category A1 locations.
- F. Ballasts for dimmer-controlled fixtures shall comply with general and fixture-related requirements above for electronic ballasts and the following features:
 - 1. Dimming Range: 100 to 5 percent of rated lamp lumens.
 - 2. Ballast Input Watts: Can be reduced to 20 percent of normal.
 - 3. Compatibility: Certified by manufacturer for use with specific dimming system indicated.

2.4 FIXTURE SUPPORT COMPONENTS

- A. Comply with Division 26 Section "Basic Electrical Materials and Methods" for channel- and angle-iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch (13-mm steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture).
- C. Twin-Stem Hangers: Two, 1/2-inch (13-mm) steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.
- D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated, 12 gage 2.68 mm.
- E. Wires For Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gage (2.68 mm).
- F. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.
- G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.
- B. Provide Unistrut support as necessary where the structure or other trades conflict.
- C. Support for Fixtures in or on Grid-Type Suspended Ceilings: Use grid for support.
 - 1. Install a minimum of four ceiling support system rods or wires for each fixture. Locate not more than 6 inches (150 mm) from fixture corners.
 - 2. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch (20-mm) metal channels spanning and secured to ceiling tees.
 - 3. Provide additional support, independent of ceiling grid for all fixtures (including incandescent) by use of jack chain having breaking strength of 3 times the weight of

the fixture (minimum of #12). Fixtures over one foot in length shall be supported at all four corners.

4. See section 260548, "Seismic Controls" for additional requirements.

D. Suspended Fixture Support: As follows:

1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
3. Continuous Rows (stem mounted): Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
4. Continuous Rows (cable mounted): Suspend from cable.
5. Support: Per NEC 410-16.

E. Air-Handling Fixtures: Install with dampers closed and ready for adjustment.

F. Adjust aimable fixtures to provide required light intensities. Adjust all fixtures to the satisfaction of the Engineer. Adjustments required at night shall be done at no additional charge. Provide all equipment needed including scaffolding, if required.

END OF SECTION

SECTION 26 5600
EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Exterior luminaires with lamps and ballasts, but not mounted on exterior surfaces of buildings.
 - 2. Luminaire-mounted photoelectric switches.
- B. See Division 26 Section "Interior Lighting" for exterior luminaires normally mounted on exterior surfaces of buildings.

1.2 RELATED DOCUMENTS:

- A. The General Conditions, Supplementary Conditions, and applicable portions of Division 1 of the specification are part of this section which shall consist of all labor, equipment, materials and other costs necessary to complete all **EXTERIOR LIGHTING** work indicated on the drawings, herein specified or both.
- B. The applicable portions of section 260500 BASIC ELECTRICAL MATERIALS AND METHODS are hereby make a part of this section. It is important that you read that section carefully because it expands upon the requirements herein.

1.3 SUBMITTALS

- A. Product Data: For each luminaire, arranged in the order of lighting unit designation. Include data on features, accessories, finishes. Provide manufacturers' catalog sheets for each lighting fixture including photograph, dimensional detail, full description and complete photometric data. Provide horizontal and vertical footcandle calculations, upon request. For floodlights, provide aiming diagrams. For area lighting, provide plan showing footcandles on ground.
- B. Shop Drawings: Anchor-bolt templates keyed to specific poles and certified by manufacturer.
- C. Operation and maintenance data.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. FMG Compliance: Fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FMG.
- C. Comply with IEEE C2, "National Electrical Safety Code."
- D. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
 2. "Packaged Price" for lighting fixtures are prohibited. See section 260500 – Basic Electrical Materials and Methods.
 3. Catalog numbers indicated in the fixture schedule are to denote type and quality. Unless otherwise indicated, fixtures of other manufacturers may be used. But, the decision of the Engineer shall be final. However, where 3 manufacturers are listed for a particular fixture, no other manufacturer will be considered.

2.2 EXTERIOR LUMINAIRES

- A. See schedule on drawings.

2.3 PHOTOELECTRIC RELAYS

- A. UL 773 or UL 773A listed, factory mounted to the luminaire.
- B. Contact Relays: Single throw, designed to fail in the on position, and factory set to turn light unit on at 1.5 to 3 fc (16 to 32 lx) and off at 4.5 to 10 fc (48 to 108 lx) with 15-second minimum time delay.
1. Relay with locking-type receptacle shall comply with NEMA C136.10.
 2. Adjustable window slide for adjusting on-off set points.

2.4 FLUORESCENT LAMP BALLASTS

- A. Ballasts shall be suitable for low-temperature environments.
1. Temperatures Minus 20 Deg F (Minus 29 Deg C) and Higher:
 2. Transient Protection: Comply with IEEE C62.41 for Category A1 locations
- B. Ballasts for compact lamps shall be suitable for cold-weather starting and shall include the following:
1. Power Factor: 90 percent, minimum.
 2. Ballast-Coil Temperature: 65 deg C, maximum.
 3. Transient Protection: Comply with IEEE C62.41 for Category A1 locations.

2.5 HIGH-INTENSITY-DISCHARGE LAMP BALLASTS

- A. General: Comply with NEMA C82.4 and UL 1029. Shall include the following features, unless otherwise indicated:
1. Type: Constant-wattage autotransformer or regulating high-power-factor type.
 2. Minimum Starting Temperature: Minus 22 deg F (Minus 30 deg C) for single-lamp ballasts.
 3. Normal Ambient Operating Temperature: 104 deg F (40 deg C).
 4. Open-circuit operation will not reduce average life.
- B. High-Pressure-Sodium Ballasts: Solid-state igniter/starter with an average life in pulsing mode of 10,000 hours at an igniter/starter-case temperature of 90 deg C.
1. Single-Lamp Ballasts: Minimum starting temperature of minus 40 deg C.
 2. Open-circuit operation will not reduce average life.

2.6 FLUORESCENT LAMPS

- A. Compact Fluorescent Lamps: CRI 80 (minimum), color temperature 3500, averaged rated life of 10,000 hours at 3 hours operation per start, unless otherwise indicated.
 - 1. T4, Double-Twin Tube: Rated 18 W, 1200 initial lumens (minimum).
 - 2. T4, Double-Twin Tube: Rated 26 W, 1800 initial lumens (minimum).

2.7 HIGH-INTENSITY-DISCHARGE LAMPS

- A. High-Pressure-Sodium Lamps: NEMA C78.42, wattage and burning position as scheduled, CRI 21 (minimum), color temperature 1900, and average rated life of 24,000 hours.
- B. Low-Pressure-Sodium Lamps: NEMA C78.41.
- C. Metal-Halide Lamps: ANSI C78.1372, wattage and burning position as scheduled, CRI 65 (minimum).

2.8 IN-LINE DISCONNECT DEVICE

- A. Each phase conductor serving pole mounted luminaries shall have a fused in-line disconnect device.
- B. Unless otherwise indicated locate inside pole opposite wiring access panel, near pole base.
- C. Provide two part device consisting of a spring loaded 90-percent minimum conductivity contact suitable for gripping the specified cartridge fuse. These contacts shall be fully annealed and adapted to be crimped to the cable and shall be adapted to be retained securely in the proper position within the rubber housing. The disconnect device housing shall consist of water resisting synthetic rubber capable of being buried in the ground. Each housing shall provide a section to form a water seal around the cable, have interior fuse contacts, and a section to provide a water seal between the two housings at the point of disconnection. Each housing shall be permanently marked "load side" or "line side". Provide fuse for the disconnecting devices rated 600 volts, 100,000 ampere interrupting capacity, 13/32-inch diameter, 1½ - inch long, with a melamine glass-fiber tube and sand filler surrounding the links.
- D. Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to: Joy Manufacturing Company, 338 South Broadway, New Philadelphia, Ohio 44663, (216) 343-3351.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install lamps in each fixture.
- B. Luminaire Attachment: Fasten to indicated structural supports.
- C. Adjust luminaries that require field adjustment or aiming to the satisfaction of the Engineer. Adjustments required at night will be done at no additional charge. Provide all equipment needed including scaffolding and bucket truck, if required.

END OF SECTION

SECTION 270500

COMMON WORK RESULTS FOR COMMUNICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sleeves for pathways and cables.
2. Sleeve seals.
3. Grout.
4. Common communications installation requirements.

1.2 SUBMITTALS

- ###### A. Product Data: For sleeve seals.

PART 2 - PRODUCTS

2.1 SLEEVES FOR PATHWAYS AND CABLES

- ###### A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- ###### B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- ###### C. Sleeves for Rectangular Openings: Galvanized sheet steel.
1. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side more than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
 - b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches (1270 mm) and 1 or more sides equal to, or more than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.2 SLEEVE SEALS

- ###### A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and pathway or cable.
1. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:
 - a. Advance Products & Systems, Inc.

- b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
 - e. Approved equal.
- 2. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of pathway or cable.
 - 3. Pressure Plates: Stainless steel. Include two for each sealing element.
 - 4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 GROUT

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

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR COMMUNICATIONS INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both communications equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR COMMUNICATIONS PENETRATIONS

- A. Communications penetrations occur when pathways, cables, wireways, or cable trays penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.
- G. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pathway or cable, unless indicated otherwise.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
 - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and pathway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants".
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pathway and cable penetrations. Install sleeves and seal pathway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."
- K. Roof-Penetration Sleeves: Seal penetration of individual pathways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using cast-iron pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between pathway or cable and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

- A. Install to seal exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for pathway or cable material and size. Position pathway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pathway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for communications installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

END OF SECTION

SECTION 271500

COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pathways.
2. UTP cabling.
3. Cable connecting hardware, patch panels, and cross-connects.
4. Telecommunications outlet/connectors.
5. Cabling identification products.
6. Cabling administration system

1.2 HORIZONTAL CABLING DESCRIPTION

- A. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the communications equipment room. This cabling and its connecting hardware are called "permanent link," a term that is used in the testing protocols.
1. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications outlet/connector.
 2. Bridged taps and splices shall not be installed in the horizontal cabling.

1.3 PERFORMANCE REQUIREMENTS

- A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA/EIA-568-B.1, when tested according to test procedures of this standard.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings:
1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
 2. Cabling administration drawings and printouts.
 3. Wiring diagrams to show typical wiring schematics.
- C. Qualification Data: For qualified layout technician, installation supervisor, and field inspector.
- D. Source quality-control reports.
- E. Field quality-control reports.

- F. Maintenance data.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
 - 1. Layout Responsibility: Preparation of Shop Drawings and field testing program development by an RCDD.
 - 2. Installation Supervision: Installation shall be under the direct supervision of Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.
- B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 25 or less.
 - 2. Smoke-Developed Index: 50 or less.
- 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. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.
- E. Grounding: Comply with ANSI-J-STD-607-A.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site. Test each pair of UTP cable for open and short circuits.

PART 2 - PRODUCTS

2.1 PATHWAYS

- A. Cable Support: NRTL labeled for support of Category 6 cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.
 - 1. Support brackets with cable tie slots for fastening cable ties to brackets.
 - 2. Lacing bars, spools, J-hooks, and D-rings.
 - 3. Straps and other devices.
- B. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems."
 - 1. Outlet boxes shall be no smaller than 2 inches (50 mm) wide, 3 inches (75 mm) high, and 2-1/2 inches (64 mm) deep.

2.2 BACKBOARDS

- A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 48 inches. Comply with requirements in Division 06 Section "Rough Carpentry" for plywood backing panels.

2.3 UTP CABLE

1. Belden CDT Inc.; Electronics Division.
2. Berk-Tek; a Nexans company.
3. CommScope, Inc.
4. Draka USA.
5. Genesis Cable Products; Honeywell International, Inc.
6. KRONE Incorporated.
7. Mohawk; a division of Belden CDT.
8. Nordex/CDT; a subsidiary of Cable Design Technologies.
9. Superior Essex Inc.
10. SYSTIMAX Solutions; a CommScope, Inc. brand.
11. 3M.
12. Tyco Electronics/AMP Netconnect; Tyco International Ltd.
13. Approved equal.

- B. Description: 100-ohm, 4-pair UTP, covered with a blue thermoplastic jacket.

1. Comply with ICEA S-90-661 for mechanical properties.
2. Comply with TIA/EIA-568-B.1 for performance specifications.
3. Comply with TIA/EIA-568-B.2, Category 6.
4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
 - a. Communications, General Purpose: Type CM or CMG.

2.4 UTP CABLE HARDWARE

1. American Technology Systems Industries, Inc.
2. Dynacom Corporation.
3. Hubbell Premise Wiring.
4. KRONE Incorporated.
5. Leviton Voice & Data Division.
6. Molex Premise Networks; a division of Molex, Inc.
7. Nordex/CDT; a subsidiary of Cable Design Technologies.
8. Panduit Corp.
9. Siemon Co. (The).
10. Tyco Electronics/AMP Netconnect; Tyco International Ltd.
11. Approved equal.

- B. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.

- C. Connecting Blocks: 110-style IDC for Category 6. Provide blocks for the number of cables terminated on the block, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated.

- D. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.
 - 1. Number of Terminals per Field: One for each conductor in assigned cables.
- E. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.
 - 1. Number of Jacks per Field: One for each four-pair UTP cable indicated.
- F. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.
- G. Patch Cords: Factory-made, four-pair cables in 36-inch (900 mm) lengths; terminated with eight-position modular plug at each end.
 - 1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6 performance. Patch cords shall have latch guards to protect against snagging.
 - 2. Patch cords shall have color-coded boots for circuit identification.

2.5 TELECOMMUNICATIONS OUTLET/CONNECTORS

- A. Jacks: 100-ohm, balanced, twisted-pair connector; four-pair, eight-position modular. Comply with TIA/EIA-568-B.1.
- B. Workstation Outlets: one-port-connector assemblies mounted in single faceplate.
 - 1. Plastic Faceplate: High-impact plastic. Coordinate color with Division 26 Section "Wiring Devices."
 - 2. For use with snap-in jacks accommodating any combination of UTP work area cords.
 - a. Flush mounting jacks, positioning the cord at a 45-degree angle.

2.6 GROUNDING

- A. Comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.
- B. Comply with ANSI-J-STD-607-A.

2.7 IDENTIFICATION PRODUCTS

- A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- B. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

2.8 SOURCE QUALITY CONTROL

- A. Factory test UTP cables on reels according to TIA/EIA-568-B.1.
- B. Cable will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

- A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

3.2 WIRING METHODS

- A. Wiring Method: Install cables in raceways except within consoles, cabinets, desks, and counters. Conceal raceway and cables except in unfinished spaces.
 - 1. Install plenum cable in environmental air spaces, including plenum ceilings.
 - 2. Comply with requirements for raceways and boxes specified in Division 26 Section "Raceway and Boxes for Electrical Systems."
- B. Wiring Method: Conceal conductors and cables.
- C. Wiring within Enclosures: Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.3 INSTALLATION OF PATHWAYS

- A. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.
- B. Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems" for installation of conduits and wireways.
- C. Install manufactured conduit sweeps and long-radius elbows whenever possible.
- D. Pathway Installation in Communications Equipment Rooms:
 - 1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed, or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.
 - 2. Install cable trays to route cables if conduits cannot be located in these positions.
 - 3. Secure conduits to backboard when entering room from overhead.
 - 4. Extend conduits 3 inches (76 mm) above finished floor.
 - 5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

- E. Backboards: Install backboards with 48-inch dimension vertical. Butt adjacent sheets tightly, and form smooth gap-free corners and joints.

3.4 INSTALLATION OF CABLES

- A. Comply with NECA 1.

- B. General Requirements for Cabling:

1. Comply with TIA/EIA-568-B.1.
2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
3. Install 110-style IDC termination hardware unless otherwise indicated.
4. MUTOA shall not be used as a cross-connect point.
5. Consolidation points may be used only for making a direct connection to telecommunications outlet/connectors:
 - a. Do not use consolidation point as a cross-connect point, as a patch connection, or for direct connection to workstation equipment.
6. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
7. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
8. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
9. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
10. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
11. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
12. In the communications equipment room, install a 10-foot- (3-m-) long service loop on each end of cable.
13. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

- C. UTP Cable Installation:

1. Comply with TIA/EIA-568-B.2.
2. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.

- D. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

- E. Group connecting hardware for cables into separate logical fields.

F. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA/EIA-569-A for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (610 mm).
3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).
4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (76 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).
5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.5 FIRESTOPPING

- A. Comply with requirements in Division 07 Section "Penetration Firestopping."
- B. Comply with TIA/EIA-569-A, Annex A, "Firestopping."
- C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.6 GROUNDING

- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with ANSI-J-STD-607-A.

- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.7 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
 - 1. Color-code cross-connect fields. Apply colors to voice and data service backboards, connections, covers, and labels.
- B. Comply with requirements in Division 09 Section "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.
- C. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for Class 2 level of administration.
- D. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.
- E. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606-A. Furnish electronic record of all drawings, in software and format selected by Owner.
- F. Cable and Wire Identification:
 - 1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
 - 2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
 - 3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet (4.5 m).
 - 4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
 - a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.
 - b. Label each unit and field within distribution racks and frames.
 - 5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware.

Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

- G. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA-606-A.

- 1. Cables use flexible vinyl or polyester that flex as cables are bent.

3.8 FIELD QUALITY CONTROL

A. Tests and Inspections:

- 1. Visually inspect UTP cable jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA/EIA-568-B.1.
- 2. Visually confirm Category 6, marking of outlets, cover plates, outlet/connectors, and patch panels.
- 3. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
- 4. Test UTP backbone copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.

- a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

5. UTP Performance Tests:

- a. Test for each outlet. Perform the following tests according to TIA/EIA-568-B.1 and TIA/EIA-568-B.2:

- 1) Wire map.
 - 2) Length (physical vs. electrical, and length requirements).
 - 3) Insertion loss.
 - 4) Near-end crosstalk (NEXT) loss.
 - 5) Power sum near-end crosstalk (PSNEXT) loss.
 - 6) Equal-level far-end crosstalk (ELFEXT).
 - 7) Power sum equal-level far-end crosstalk (PSELFEXT).
 - 8) Return loss.
 - 9) Propagation delay.
 - 10) Delay skew.

- 6. Final Verification Tests: Perform verification tests for UTP systems after the complete communications cabling and workstation outlet/connectors are installed.

- a. Voice Tests: These tests assume that dial tone service has been installed. Connect to the network interface device at the demarcation point. Go off-hook and

listen and receive a dial tone. If a test number is available, make and receive a local, long distance, and digital subscription line telephone call.

- b. Data Tests: These tests assume the Information Technology Staff has a network installed and is available to assist with testing. Connect to the network interface device at the demarcation point. Log onto the network to ensure proper connection to the network.

- B. Document data for each measurement. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.

- C. Prepare test and inspection reports.

3.9 DEMONSTRATION

- A. Train Owner's maintenance personnel in cable-plant management operations, including changing signal pathways for different workstations, rerouting signals in failed cables, and keeping records of cabling assignments and revisions when extending wiring to establish new workstation outlets.

END OF SECTION

SECTION 28 4621
FIRE ALARM - ADDRESSABLE

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes the furnishing of all labor, equipment, materials, testing, and performance of all operations in connection with the installation of an addressable multiplex analog fire alarm system.

1.2 RELATED DOCUMENTS

- A. The General Conditions, Supplementary Conditions, and applicable portions of Division 1 of the specification are part of this section which shall consist of all labor, equipment, materials and other costs necessary to complete all FIRE ALARM - ADDRESSABLE work indicated on the drawings, herein specified or both.
- B. The applicable portions of section 260500 BASIC ELECTRICAL MATERIALS AND METHODS are hereby make a part of this section. It is important that you read that section carefully because it expands upon the requirements herein.
- C. Sprinkler flow switches and gate valve switches – See Division 21.

1.3 DEFINITIONS:

- A. FACP: Fire Alarm Control Panel
- B. LED: Light-emitting Diode
- C. Definitions in NFPA 72 apply to this section.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings:
 - 1. System Operation Description: Detailed description for this Project, including method of operation and supervision of each type of circuit and sequence of operations for manually and automatically initiated system inputs and outputs. Manufacturer's standard descriptions for generic systems are not acceptable.
 - 2. Device Address List: Coordinate with final system programming.
 - 3. System riser diagram with device addresses, conduit sizes, and cable and wire types and sizes.
 - 4. Wiring Diagrams: Power, signal, and control wiring. Include diagrams for equipment and for system with all terminals and interconnections identified. Show wiring color code.
 - 5. Batteries: Size calculations.
- C. Field quality-control test reports.
- D. Operation and maintenance data.

- E. Submittals to Authorities Having Jurisdiction: In addition to distribution requirements for submittals specified in Division 1 Section "Submittals," make an identical submittal to authorities having jurisdiction. To facilitate review, include copies of annotated Contract Drawings as needed to depict component locations. Resubmit if required to make clarifications or revisions to obtain approval. On receipt of comments from authorities having jurisdiction, submit them to Engineer for review.
- F. Documentation:
 - 1. Approval and Acceptance: Provide the "Record of Completion" form (Inspection and Testing Form) according to NFPA 72.
 - 2. Record of Completion Documents: Provide the "Permanent Records" according to NFPA 72. Format of the written sequence of operation shall be the optional input/output matrix. See A-7-5.2.2(i).

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Manufacturers Label: All equipment must be labeled with the manufacturers name to assure the integrity of the complete system. "Hybridized" systems (containing equipment from several different manufacturers) shall not be considered acceptable.
- D. Compliance: The complete installation must comply with applicable sections of NFPA – 72 and all local requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Edwards Systems Technology Inc.(E.S.T.)
 - 2. Fire Control Instruments, Inc.(F.C.I.)
 - 3. Notifier.

2.2 SYSTEM OPERATION

- A. General Requirements:
 - 1. Each EST-3 network panel/node shall support addressable/analog Signature Series sensor and modules as well as traditional initiating and indicating circuits simultaneously intermixed in any EDWARD SYSTEMS TECHNOLOGY, INC. EST-3 Network Controller. In the sequence of operations described below, an indicating circuit shall be Class "A", or addressable (SIGA-UM) module configured Class "A". In the description below a signaling circuit (horn, strobes, speakers, or emergency telephone) shall be Class "A" or an addressable (SIGA-UM) module configured Class "A". Initiating circuits used for manual stations, water flow, tampers four-wire duct detectors, etc., shall use addressable I/O modules (SIGA-UM) or traditional Class "A" circuits.

However, analog addressable sensors shall be SIGA-HFS, SIGA-HRS, SIGA-IS, SIGA-PS, SIGA-PHS OR SIGA-IPHS only.

B. Sequence of Operation:

1. The system shall identify the operation of a manual station, activation of any system smoke detector, any off normal condition, and log each condition into the system database as an event.
2. The system shall automatically display on the control panel liquid crystal display the first event of the highest priority by type. The priorities and types shall be alarm, supervisory, trouble and monitor.
3. The system shall have a queue operation, and shall not require event acknowledgment by the system operator. The system shall have a labeled color-coded indicator for each type of event; alarm-red, supervisory-yellow, trouble yellow, monitor-green which shall turn on when active events exist.
4. For each event, the display shall include the current time, the total number of events, the type of event, and the time the event occurred and up to a 40-character custom user description.
5. The user shall be able to silence the local signal and review each event by simply selecting scrolling keys (up/down) for each event type.
6. New supervisory or trouble events shall sound a signal that can be silenced, at the control panel.
7. The operation of any manual station or activation of any system smoke detector, thermal detector, sprinkler flow switch, or any automatic alarm-initiating device shall automatically:
 - a. Update the control/display as described above.
 - b. Sound all alarm signals throughout the building at the evacuation rate.
 - c. Turn on all strobe lights throughout the building.
 - d. Initiate the transmission of an alarm to the local fire department via the required connection.
 - e. Operate addressable control relay contacts to shutdown all HVAC units.
 - f. Operate addressable control relay contacts to return all elevators that serve the floor of alarm initiation to the ground floor. If the alarm originates from the ground floor, operate control circuit contacts to return all elevators to the alternate floor as directed by the local fire department.
 - g. Operate addressable control relay contacts to operate the smoke evacuation fans.
8. The entire fire alarm system wiring shall be electrically supervised to automatically detect and report trouble conditions to the fire alarm control panel. Any grounds or disarrangement of system wiring and shorts across alarm horn/strobe wiring shall automatically:
 - a. Update the control/display as described above.

2.3 CONTROL PANEL

- A. The fire alarm control panels shall be Edwards Systems Technology (EST) type EST3 series, or approved equal and shall incorporate all control electronics, relays, and necessary modules and components in a surface mounted cabinet. The operating controls zone/supervisory indicators shall be located behind locked door with a viewing window. All control modules shall be labeled, and all zone locations shall be identified. The cabinet shall be steel, with a gray finish. The assembly shall contain a base panel, system power supply

and battery charger with optional modules suitable to meet the requirements of these specifications.

- B. System shall be configured as follows: Addressable analog loops Class A, initiating Device Circuits Class A; Notification Appliance Circuits Class A.
- C. The system shall be supervised, site programmable, and of modular design with expansion modules to serve up to 960 detectors and 940 remote modules, and four notification appliance circuits (NAC's) convertible to power risers to serve remote multiple NAC modules for zoned signal applications.
- D. The system shall store all basic system functionality and job specific data in non-volatile memory. The system shall survive a complete power failure intact.
- E. The system shall have built-in automatic system programming to automatically address and map all system devices and provide a minimum default single stage alarm system operation with support of alarm silence, trouble silence, drill, lamp test, and reset common controls.
- F. The system shall allow down loading of a job specific custom program created by system application software. It shall support programming of any input point to any output point. The system shall support the use of Bar Code readers to assist custom programming functions. It shall allow authorized customization of fundamental system operations using initiating events to start actions, timers, sequences and logical algorithms.
- G. The system shall support distributed processor intelligent detectors with the following operational attributes; integral multiple differential sensors, automatic device mapping, electronic addressing, environmental compensation, pre-alarm, dirty detector identification, automatic day/night sensitivity adjustment, dual normal/alarm LEDs, relay bases, and isolator bases.
- H. The system shall use full digital communications to supervise all addressable loop devices for placement, correct location, and operation. It shall allow swapping of "same type" devices without the need of addressing and impose the "location" parameters on replacement device. It shall initiate and maintain a trouble if a device is added to a loop and clear the trouble when the new device is mapped and defined into the system.
- I. The system shall have a U.L. Listed Detector Sensitivity test feature, which will be a function of the smoke detectors and performed automatically every 4 hours.
- J. The system shall support 100% of all remote devices in alarm and provide support for a 100% compliment of detector isolator bases.
- K. All panel modules shall be supervised for placement and return trouble if damaged or removed.
- L. The system shall have a CPU watchdog circuit to initiate trouble should the CPU fail.
- M. The system shall provide a coded one man walk test feature. Allow audible or silent testing. Signal alarms and troubles during test. Allow receipt of alarms and programmed operations for alarms from areas not under test.
- N. The system shall provide internal system diagnostics and maintenance user interface controls to display/report the power, communication, and general status of specific panel components, detectors, and modules.
- O. The system shall provide loop controller diagnostics to identify common alarm, trouble, ground fault, Class A fault, and map faults. Map faults include wire changes, device type

changes by location, device additions/deletions and conventional open, short, and ground conditions. Ground faults on the circuit wiring of remote module shall be identified by device address.

- P. The control shall allow the user to display/report the condition of addressable analog detectors. Include device address, device type, percent obscuration, and maintenance indicator. The maintenance indicator shall provide the user with a measure of contamination of a device upon which cleaning decisions can confidently be made.
- Q. The control shall allow the user to report history for alarm, supervisory, monitor, trouble, smoke verification, and restore activity. Include Facility Name, Licensee, Project Program Compilation date, Compiler Version, Project Revision Number, and the time and date of the History Report.
- R. Each control/node shall allow the user to disable/enable devices, zones, actions, timers and sequences. Protect the disable function with a password.
- S. Each control/node shall allow the user to activate/restore outputs, actions, and sequences.
- T. Each control/node shall allow the service user to enter time and date, reconfigure an external port for download programming, initiate auto programming and change passwords. Protect these functions with a password.
- U. Control shall provide automatic/on/off control switches for manual override of HVAC units.
- V. Each control panel/node shall have peer-to-peer network communications and shall provide full system operation from any node. It shall be possible to support a single stand-alone node or network up to 5 control panel nodes and 5 network annunciators on a peer-to-peer network. It shall be required to operate the system from multiple system user interfaces where provided. Network alarm response must be under 3 seconds. Status LEDs shall be provided for communications of network, RS-232, audio and internal communications. An ISO 9001 standards listed company must manufacture the control panel and system components. The communication format between the control panel and analog devices shall be digital. Loop alarm recognition must be within 750 milliseconds of a device reporting an alarm state. It must be possible to wire the analog device loop as Class A or Class B with non-shielded, non-twisted wire.
- W. The system shall provide a user interface that displays system events in a text format, and supports basic common control LEDs switches. The common control switches and LEDs provided as minimum will be; reset switch and LED, alarm silence switch and LED, panel silence switch and LED, drill switch and LED. It must be possible to add additional common controls as required through the use of modular display units. The user interface must provide an LCD that will allow display of custom event messages. Events shall be automatically placed in easy access queues. It shall be possible to view specific queue event types separately. Having to scroll through a missed list of event types is not acceptable. The total number of active events by type must be displayed. Visual indication must be provided for any event type that has been acknowledged or viewed. The life safety system shall incorporate annunciation of alarm, supervisory, trouble and monitor operations. Annunciations must be through the use of LED display strips complete with means to custom label each LED as to its function. Where applicable control of remote control devices must be made available at the control center. Switches with LEDs must provide positive feed back to the operator of remote equipment status.
- X. Single Input Module, SIGA-CC1

1. Provide intelligent single input signal modules SIGA-CC1. The Single Input (Single Riser Select) Signal Module shall provide one (1) supervised output circuit capable of a minimum of 2 personalities, each with a distinctive operation. When selected as a telephone power selector, the module shall be capable of generating its own “ring tone”.
2. The module shall be suitable for mounting on North American 2 ½ (64 mm) deep 2-gang boxes and 1 ½” (38mm) deep 4” square boxes with 2-gang covers, or European 100mm square boxes. The single input signal module shall support the following operations:
 - a. Audible/Visible Signal Power Selector (Polarized 24 V DC @ 2A, 25V rms @ 50w or 70 V rms @ 35 Watts of Audio)

2.4 PERIPHERAL DEVICES

A. Detectors:

1. General:
 - a. Detectors shall be capable of full digital communications using both broadcast and protocol. Each detector shall be capable of performing independent fire detection algorithms. The fire detection algorithm shall measure sensor signal dimensions, time Patterns and combine different fire parameters to increase reliability and distinguish real fire conditions from unwanted deceptive nuisance alarms. Signal patterns that are not typical of fires shall be eliminated by digital filters. Devices not capable of combining different fire parameters or employing digital filters shall not be acceptable.
 - b. Each detector shall have an integral microprocessor capable of making alarm decisions based on fire parameter information stored in the detector head. Distributed intelligence shall improve response time by decreasing the data flow between detector and analog loop controller.
 - c. Detectors not capable of making independent alarm decisions shall not be acceptable. Maximum total analog loop response time for detectors shall be 0.5 seconds.
 - d. Each detector shall have a separate means of displaying communication and alarm status. A green LED shall flash to confirm communication with the analog loop controller. A red LED shall flash to display alarm status. Both LEDs on steady shall indicate alarm-stand alone mode status.
 - e. Both LEDs shall be visible through a full 360 degree viewing angle.
 - f. The detector shall be capable of identifying up to 32 diagnostic codes. This information shall be available for system maintenance. The diagnostic code shall be stored at the detector.
 - g. Each detector shall be capable of transmitting pre-alarm signals in addition to the normal, trouble and need cleaning information. It shall be possible to program control panel activity to each level.
 - h. Each detector microprocessor shall contain an environmental compensation algorithm, which identifies and sets ambient “environmental thresholds” approximately six times an hour. The microprocessor shall continually monitor the environmental impact of temperature, humidity, other contaminants as well as detector aging. The processor shall employ digital compensation to adapt the detector to long term environmental changes. The microprocessor shall monitor the environmental compensation value and alert the system operator when the detector approaches 50% and 100% of the allowable environmental compensation value.

- i. Differential sensing algorithms shall maintain a constant differential between elected detector sensitivity and the “learned base line sensitivity”. The base line sensitivity information shall be permanently stored at the detector approximately once every hour.
 - j. Each detector may be individually programmed to operate at any one of five (5) sensitivity setting.
 - k. The intelligent analog device and analog loop controller shall provide increased reliability and inherent survivability through intelligent analog conventional operation. The device shall automatically change to stand alone, conventional device operation in the event of a loop controller polling communications failure. In the analog conventional detector mode, the analog detector shall continue to operate using Sensitivity and environmental compensation information, stored in its microprocessor at the time of communication failure. The analog loop controller shall monitor the loop and activate a loop alarm if a detector reaches its alarm sensitivity threshold.
 - l. Each signature series device shall be capable of automatic electronic addressing and/or custom addressing without the use of DIP or rotary switches. Devices using DIP or rotary switches for addressing, either in the base or on the detector shall not be acceptable.
 - m. It shall be possible to program the signature series analog devices into a minimum of 16 groups with a minimum of 32 devices per group. It shall also be possible to link groups to program activities.
 - n. The intelligent analog detectors shall be suitable for mounting on any type SIGA-SB signature series detector-mounting base. Isolator bases, EST type SIGA-IB shall be installed where shown on plans.
 - o. Detectors shall not be installed within 10 inches of electronic ballast type light fixtures.
2. Addressable Fixed Temperature Heat Detectors-SIGA-HFS
- a. The intelligent heat detector (SIGA-HFS) shall have a thermistor heat sensor and operate at a fixed temperature. It shall continually monitor the temperature of the air in its surroundings to minimize thermal lag to the time required to process an alarm.
 - b. The integral microprocessor shall determine if an alarm condition exists and initiate an alarm based on the analysis of the data. Systems using central intelligence for alarm decisions shall not be acceptable.
 - c. The heat detector shall have a nominal rating of 135 degrees F (57 degrees C).
3. Addressable Fixed Temperature/Rate-Of-Rise Heat Detector-SIGA-HRS
- d. The intelligent combination fixed temperature/rate-of-rise heat detector (SIGA-HRS) shall have a thermistor heat sensor and operate at a fixed temperature at a predetermined temperature rise. It shall continually monitor the temperature of the air in its surroundings to minimize thermal lag to the time required to process an alarm.
 - e. The integral microprocessor shall determine if an alarm condition exists and initiate an alarm based on the analysis of the data. Systems using central intelligence for alarm decisions shall not be acceptable.
 - f. The intelligent heat detector shall have a nominal fixed temperature of 135 degrees F (57 degrees C) and a rate of rise rating of 15 degrees F (9 degrees C)/minute.
 - g. The heat detector shall have a minimum linear spacing rating of 70-foot (21.3m) centers and be suitable for wall mount application.

4. Intelligent Detectors-Photoelectric Smoke Detectors – SIGA-PS

- a. The intelligent analog photoelectric detector (SIGA-PS) shall utilize a light scattering type photoelectric smoke sensor to sense changes in air samples from its surroundings. The integral microprocessor shall dynamically examine values from the sensor and initiate an alarm based on the analysis of data. Systems using central inelegance for alarm decisions shall not be acceptable. The detector shall continually monitor any changes in sensitivity due to environmental effects of dirt, smoke, temperature, aging and humidity. The information shall be stored in the integral processor and transferred to the analog loop controller for retrieval using a laptop PC or the SIGA-PRO signature program/service tool. The photo detector shall be rated for ceiling installation at a minimum of 30 ft. (9.1m) centers and be suitable for wall mount applications. The photoelectric smoke detector shall be suitable for direct insertion into air ducts up to 3 ft. (.91m) high and 3 ft. (0.91m) wide with air velocities up to 5,000 ft/min (0-25.39 m/sec) without requiring specific duct detector housings or supply tubes.
- b. The percent smoke obscuration per for alarm set point shall be field selectable to any five sensitivity settings ranging from 1.0% to 3.5%. The photo detector shall be suitable for operation in the following environment:

Temperature: 32F to 120F (0C to 49C)
Humidity: 0-93% RH non-condensing

3. Addressable Duct Detector, SIGA-SD

- a. Provide a mounting assembly with a signature series detector with sample tube.
- b. Locate duct detector according to NFPA 72 recommendations.
- c. Provide remote alarm LED and key operated detector test switch, type SD-TRK, where shown on plans.

4. Standard Bases – SIGA-SB

- a. The base SIGA-SB shall, contain no electronics, support all signature series detect types and have the following minimum requirements:
 - a. Removal of the respective detector shall not affect communications with other detectors.
 - b. Terminal connections shall be made on the room side of the base. Bases which must be removed to gain access to the terminals shall not be acceptable.
 - c. The standard detector base shall be capable of supporting one (1) signature series SIGA-LED, (red) remote alarm indicator.

B. Addressable Control Relay Module SIGA-CR

1. The intelligent microprocessor based control relay module (SIGA-CR) shall provide once for "C" dry relay contact rated 2 amps at 24VDC to control external appliances or Equipment shutdown. The control relay shall be rated for pilot duty and releasing systems.
 - a. The position of the relay contact shall be confirmed by the system firmware.

- b. The control relay module shall have a minimum of 2 diagnostic LEDs mounted behind finished cover plate. A green LED shall flash to confirm communication with the loop controller. A red LED shall flash to display alarm status. The module shall be capable of storing up to 24 diagnostic codes.
- c. Terminal connections shall be accessible from the room side of the assembly. Devices which must be removed to gain access to the wiring terminals shall not be acceptable.

C. Addressable Universal Class A/B Module SIGA-UM

- 1. The intelligent universal class A/B module (SIGA-UM) shall be capable of a minimum of 15 distinct operations.
 - a. The personality of the module shall be programmable at site to suit conditions and may be changed at any time using a personality code downloaded from the analog loop controller. Signal function modules or modules requiring EPROM, ROM or PROM changes or DIP switch/jumper changes shall not be acceptable.
- 2. The universal class A/B module shall support the following circuit types:
 - a. Two Class B or one Class A initiating device circuits (IDC) capable of delayed water flow alarm operation.
 - b. One Class A or B indicating device (signal) appliance circuit (IAC)
 - c. One Class A or B circuit for 2 wire smoke detectors (verified or non-verified)
 - d. One form "C" (NO/NC) dry output contact relay.
- 3. Input/output circuit wiring shall be supervised for open and ground faults.
- 4. The universal Class A/B module shall have a minimum of 2 diagnostic LEDs mounted behind finished cover plate. A green LED shall flash to confirm communication with the loop controller. A red LED shall flash to display alarm status. The module shall be capable of storing up to 24 diagnostic codes.
- 5. Terminal connections shall be accessible from the room side of the assembly devices.
- 6. The universal Class A/B module shall be suitable for operation in the following environment:

Temperature: 32 degrees F to 120 degrees F (0 degrees C to 49 degrees C)
Humidity: 0-93% RH, non-condensing
- 7. It shall be possible to address each signature series module without the use of DIP or rotary switches. Devices using DIP switches for addressing shall not be acceptable.

D. Addressable Intelligent Double Action Fire Alarm Station, SIGA-278

- 1. Provide intelligent double action; single stage non-coded fire alarm stations (SIGA-278). The fire alarm station shall be of lexan construction with an internal tongue switch. Provide a locked test feature. Finish the station in red with white "PULL IN CASE OF FIRE" lettering.
- 2. The intelligent fire alarm station shall have a minimum of 2 diagnostic LEDs a green LED shall flash to confirm communication with the loop controller. A red LED shall flash to display alarm status. The fire alarm station shall be capable for storing up to 24 diagnostic codes.

3. It shall be possible to address each signature series module without the use of DIP or rotary switches. Devices using DIP or rotary switches for addressing shall not be acceptable.
- F. 1500 Series Magnetic Door Holder
1. Corridor magnetic door holder shall be EST type 1500 series installed where shown on plans. Units shall be wall or floor mounted as shown. Units shall be 24VDC powered from the fire alarm control. Units shall be 120VAC powered and shall be wired in separate conduit.
- H. Horn/Strobe
1. Provide EST type GENSIS series low profile alarm horn/strobe unit where shown on plans. Strobe lights shall be instantly self-synchronizing, for improved safety for photosensitive people, without the use or requirement of additional wiring or circuit/panel modules, and shall meet the requirement of additional wiring or circuit/panel modules, and shall meet the requirements of UL1971, and Americans with Disabilities Act. Horn/strobe unit shall be rated at 94db at low frequency for superior “through-the-wall” sound penetration. Units shall be semi-flush mounted, low profile and shall provide “FIRE” marking. Surface mounted units where shown on plans shall be installed in a finished box. Units shall be designed and manufactured to ISO 9001 quality standards. Strobe-only units shall be type 202.
- J. Mini Horn Only
1. Provide EST type GENESIS horn only unit where shown on plans. Units shall be semi-flush mounted without the requirement of separate trim plate. Surface mounted units where shown on plans shall be installed in a finished box. Units shall be designed and manufactured to ISO 9001 quality standards.
- K. Remote Extender Panel
1. Provide EST type BPS remote extender panel as required. Unit shall be rated at 6 or 10 amps as required and shall provide minimum of two additional circuits each, programmable software input to output correlation, complete panel supervision and battery stand-by power.
- N. Alpha-Numeric Annunciator
1. Provide EST type LSRA remote annunciator where shown on plans. Unit shall provide liquid crystal alpha-numeric display with a minimum of four lines with twenty characters per line. Annunciator shall be provided with a key-switch, enabled reset, alarm silence, trouble silence and drill/all call switches. It must be possible through programming to determine which switch common control functions are active with the key-switch in the enable or disable position. It must be possible to have up to 31 of any type of LSRA (-C) and SMDN (-C) annunciators on a single annunciator network. It must provide regenerative functions in the event of communications failure. Each annunciator must be capable of supporting custom messages as well as system even annunciation. It must be possible to filter unwanted annunciation of trouble, alarm or supervisory functions. The annunciator must incorporate a power saving feature. The front panel back lighting must turn off after a minimum of four minutes if there is no switch activity and no messages waiting. It must be possible to connect a printer directly to the annunciator through a dedicated RS-232 port. The printer to facilitate generation of hard copy records of system activity. The annunciators shall

be mounted in stand-alone enclosures to be integrated into the network panels as indicated on the plans. The annunciator must be able to automatically seek specific messages for other parties of the network if no message resides in its database.

O. Sprinkler/Gate Valve Switches and Flow Switches

1. Sprinkler flow switches and gate valve switches shall be furnished and installed by the sprinkler contractor. Units shall connect to the intelligent analog loop via type SIGA-UM intelligent monitor module. Each switch shall be wired to the monitor module with Class A wiring.

P. Circuit Isolator Modules

1. Provide EST type SIGA-IM isolator module to provide short circuit protection. This module shall install on a standard 4" square electrical box and shall be installed every 25 devices. In no case shall the length of an area disabled by a wire to wire short circuit fault exceed two hundred feet (200') in any one direction. When a common SLC serves more than one floor of a building, circuit isolation modules shall be installed to prevent a wire to wire short circuit fault on one floor from disabling the SLC on any other floor.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

- A. HVAC: Locate detectors not closer than 3 feet (1 m) from air-supply diffuser or return-air opening.
- B. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of the duct.
- C. Detector locations shall be no closer than 3 feet from air supply outlets nor in beam pockets deeper than 12". No detector shall be purposely recessed in a ceiling.

3.2 WIRING INSTALLATION

- A. Install wiring according to the following:
 1. NECA 1.
 2. TIA/EIA 568-A.
- B. Wiring Method: Install wiring in metal raceway according to Division 26 Section "Raceways and Boxes."
 1. Fire alarm circuits and equipment control wiring associated with the fire alarm system shall be installed in a dedicated raceway system. This system shall not be used for any other wire or cable.
 2. All wiring shall meet NEC 760 for fire alarm system wiring. All wiring shall be tagged at junction points and shall test free of grounds and shorts between conductors.
 3. All final terminations of the field wiring shall be made by or under the direct supervision of the Fire Alarm System Manufacturer's representative.
 4. All junction boxes shall be painted red and labeled "Fire Alarm". Color coded wiring shall be maintained throughout the installation.
 5. Installation of equipment and devices relevant to other work in the contract shall be closely coordinated.
 6. An equipment bonding conductor shall be provided in all flexible metallic raceways.

- C. Alternate wiring method: Type MC cable dual rated as FPL and 2-hour fire rated by UL may be selectively, installed with written approval of the authority having jurisdiction.
- D. Color code for fire alarm systems shall be as follows:
 - 1. INITIATING DEVICE CIRCUIT (IDC/SLC) shall be red and black. Red shall be positive and black shall be negative.
 - 2. SPRINKLER/STANDPIPE CIRCUITS shall be red and black. Red shall be positive and black shall be negative.
 - 3. DOOR HOLDER CIRCUITS shall be gray and gray.
 - 4. FLASHING STROBE CIRCUIT, if separate feed is required, shall be blue and white. Blue shall be positive and white shall be negative.
 - 5. NOTIFICATION APPLIANCE CIRCUIT shall be blue and white. Blue shall be positive and white shall be negative.
 - 6. SMOKE DETECTOR those detectors requiring a separate power supply shall use the colors violet and brown. Violet shall be positive and brown shall be negative.
 - 7. AUXILIARY REMOTE POWER SUPPLY CIRCUITS shall be brown and violet. Violet shall be positive and brown shall be negative.
 - 8. MASTER BOX TRIPPING CIRCUIT shall be orange and orange. Conductors for this circuit shall be installed in a separate raceway.
 - 9. BOND WIRE from the fire alarm panel and the master box, if required by local authority having jurisdiction, shall be green.
 - 10. ELEVATOR CAPTURE CIRCUITS shall be brown and yellow.
 - 11. HVAC SHUT DOWN CIRCUITS and AUDIO/VISUAL SYSTEMS SHUTDOWN CIRCUITS shall be orange and yellow.
 - 12. REMOTE ANNUNCIATOR CIRCUITS shall be violet and numbered at each end.
 - 13. MUNICIPAL FIRE ALARM LOOP from the master box to the municipal loop shall be black and white.
- E. AC supply to the main fire alarm panel shall be white and black. Fire alarm primary power source shall be on dedicated branch circuit. Circuit breaker locks shall be used. If a separate feed is required for the battery charger it shall be black and white unless the main fire alarm panel required only AC feed. In this case the conductors to the battery charger shall be red and white and shall be on a circuit breaker of its own
- F. Conductors shall be minimum #14 gauge solid copper type THHN/THWN. Conductor's size shall be increased as required to maintain voltage drop to a maximum of 3%. All AC and DC portions of the system shall be installed in separate raceway. Addressable loop wiring may be #16 providing manufacturer's recommended distance is observed. If the system provided at no additional cost. Alarm speaker circuits shall be twisted shielded pairs. Emergency fire fighters telephone shall be twisted shielded pairs. Notification appliance circuits shall meet survivability requirements.
- G. Junctions shall not be allowed unless approved by the AHJ.
- H. Red painted terminal cabinets with hinged local covers shall be provided at all approved junction points. All conductor splices shall be made on screw type terminal blocks; wire nuts shall not be used. All terminals within terminal cabinet shall be properly labeled. Provide terminal cabinet at each building cable entrance and at other locations as required.
- I. All fire alarm initiating zone and signal wiring shall be wired Class A. Separate raceways shall be provided for outgoing and return conductors.
- J. Final connections between the equipment and the wiring system shall be made under the direct supervision of a representative of the manufacturer.

- K. Provide override for all fans, controlled via fire alarm system, from the control panel.
- L. Upon completion of the installation of fire alarm equipment, the electrical contractor shall provide to the engineer a signed statement substantially in the form as follows
 - 1. The undersigned having been engaged as the electrical contractor on this project confirms the fire alarm equipment was installed in accordance with the Specifications and also in accordance with wiring diagrams, instructions, and directions provided to us by the manufacturer.
- M. Manufacturers approval: Install all wiring in accordance with wiring diagrams, instructions and directions provided by the manufacturer.

3.3 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals according to Division 16 Section "Basic Electrical Materials and Methods".
- B. Provide identification meeting the requirements of the authority having jurisdiction.

3.4 GROUNDING

- A. Ground the FACP and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to the FACP.

3.5 PROGRAMMING

- A. Provide all programming as required for a fully operating system and meeting approval of owner and the authority having jurisdiction. All room names, numbers and other wording must meet approval of the owner and may not match contract drawings.
- B. Prior to programming, submit a complete list of all device "addresses" to the authority having jurisdiction, for final approval.
- C. All required program changes and all owner requested program changes during the first year following final approval and acceptance shall be provided at no charge to the owner.

3.6 ACCESS CODES

- A. A record of all program access codes to be given to the owner and included as part of the maintenance manuals. At end of guarantee/warranty period, update access code list, certified as accurate by the vendor, and delivered to the owner.

3.7 WARRANTY/GUARANTEE

- A. The Contractor shall guarantee all equipment and wiring to be free from inherent mechanical and electrical defects for a period of one year from the date of final acceptance.
- B. The equipment supplier shall provide the Owner with a formal written equipment guarantee upon completion of the installation and testing of the system. The guarantee period shall begin on the day of acceptance of the system by the Engineer and shall provide for a period of one year, unless a longer period is required elsewhere in these specifications.

- C. During the guarantee period, 24 hour service (365 days/year) is required of the Contractor and equipment supplier.
- D. Include, as part of the Contract, the four quarterly tests following the final acceptance test.**

3.8 FIELD QUALITY CONTROL

A. General Testing Requirements:

1. Prior to energizing any part of this system, the factory authorized representative shall check thoroughly the installation, and perform pre-start checks. This representative shall check all points, fire alarm panels and complete network to ensure proper operation, and make any needed repairs and/or replacements required. Sufficient time shall be included in the project bid to cover all required start-up assistance and testing.
2. Before requesting final approval of the installation, submit a written statement using the form for Record of Completion shown in NFPA 72.
3. Perform each electrical test and visual and mechanical inspection listed in NFPA 72. Certify compliance with test parameters.
4. Visual Inspection: Conduct a visual inspection before any testing. Use as-built drawings and system documentation for the inspection. Identify improperly located, damaged, or nonfunctional equipment, and correct before beginning tests.
5. Testing: Follow procedure and record results complying with requirements in NFPA 72.
6. Test and Inspection Records: Prepare according to NFPA 72, including demonstration of sequences of operation by using the matrix-style form in Appendix A in NFPA 70.

B. Specific Testing Requirements:

1. All testing (pre-testing, final testing, and program change testing) to be coordinated with the owner and scheduled in advance so that owner personnel can be present during testing. Contractor to certify that all tests comply with the requirements of the authority having jurisdiction.
2. Before this installation shall be considered complete and acceptable, a complete test on the system shall be performed as follows:
 - a. A pre-test will be held by the Contractor with the manufacturer's authorized representative present. After certification of a complete pre-test, the installing Contractor shall inform the authority having jurisdiction of the outcome of the test and arrange to re-inspect in the presence of the authority having jurisdiction and the manufacturer's authorized representative.
 - b. Final Test: The Contractor in the presence of an authorized representative of the manufacturer and the Fire Department, shall operate every manual station, smoke detector, and thermodetector.
 - c. Each station/detector circuit and horn circuit shall be opened in at least two locations to check for the presence of correct supervisory circuitry. When this testing has been completed to the satisfaction of the Contractor's job foreman, the fire department and the representative of the manufacturer, a letter from the Contractor cosigned by the manufacturer attesting to the satisfactory completion of said testing, shall be forwarded to the Engineer.

3.9 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the fire alarm system, appliances, and devices. The demonstration shall simulate all possible operating conditions and alarms. Schedule with owner in advance and allow for at least one follow-up visit.

END OF SECTION

SECTION 28 4624
FIRE ALARM SYSTEM MASTERBOX

Requirements for Municipal Fire Alarm Service-Radio Master Boxes

Equipment-

- All equipment in fire alarm system shall be NFPA 72 approved; this includes all fire alarm panels, relays, modules etc.
- All radio Master Boxes shall meet the requirements of NFPA 72, chapter 27.
- All radio Master Boxes shall be compatible with the Signal Communications Vision- 21 receiver.

Before Installation-

All radio boxes, Gamewell shells and limit switches shall be brought to the Fire Alarm Superintendent for inspection and approval. This includes the radio box, RF Cable and Gamewell shell. **Any Equipment not meeting the manufacturers or Fire Department requirements will not be accepted.**

Requirements for radio fire alarm systems.

1. Permits

1.1 All work shall have appropriate permits as required under MA General Law.

2. Installation

2.1 The entire system shall be installed according to the following: **Manufacturer installation requirements.** NFPA 72, and NFPA 1221.

2.2 Radio alarm box and the Fire Alarm Control Panel shall be located inside the main entry or front vestibule of the protected property, unless approved by Fire Alarm Superintendent and Fire Prevention Office. The radio box must be mounted at the same height as the FACP and accessible from the floor without the need for a ladder.

2.3 The Fire Alarm Control Panel shall be connected to the radio alarm box in such a way that when a zone is activated, only the corresponding zone of the radio alarm box will be activated.

2.4 The Onset Fire Department will issue the Master Box number assignment.

2.5 Radio alarm boxes shall be programmed to self-test once daily, the Onset Fire Department will assign this time of test.

2.6 A surge arrester shall be installed on the AC power leads of the radio box.

2.7 Radio alarm boxes shall be programmed for a 30 second delay in transmitting a trouble condition. FACP troubles shall not transmit to the Fire Department via the radio box. Only the following box troubles shall transmit to the Fire Department: Low Battery, no AC power (program for 3-4 hour delay), zone connection trouble, radio transmitter/antenna trouble and door tamper, along with any other zones or troubles fire prevention deems necessary.

2.8 Radio alarm boxes will be programmed with door open tamper switch active.

2.9 A Gamewell 3-fold style shell shall be installed at the main entrance of the building. The door shall have a limit switch installed on it to activate the radio box when the Gamewell box is pulled. The FACP shall announce at the panel, but not sound the horn strobes within the building. This point shall be programmed as non-latching, so the FACP will clear when the reset button on the limit switch is pressed. This box shall be visible from the street and have a red light installed over it. The Gamewell shell shall be mounted according to ADA height requirements. The light shall be lit at all times and be on the same circuit as the FACP. The light source for the light shall be an Edison based LED bulb.

3. Antenna Requirements

3.1 Antennas for radio alarm boxes shall be installed according to the following:

-Manufacturer installation requirements, NFPA 72 and NFPA 1221.

3.2 Antenna location to be determined during consultation with Onset Fire Department.

3.3 Any antenna cable run under 100 ft. shall be RG213, cable runs over 100 ft. shall be LMR-400.

3.4 A rigid aluminum or galvanized steel conduit shall protect any antenna cable for the entire cable run.

3.5 Service box or weather head at antenna.

3.6 The antenna shall be located at least 20 feet away from any HVAC equipment or other metal enclosures on the roof, any changes shall be approved by Fire Alarm Superintendent and Fire Prevention Office.

4. Scheduling

4.1 Connecting to the municipal Fire Alarm requires advanced notice. Call at least 3 business days ahead to schedule connection.

4.2 A member of the Onset Fire Department must be present when the radio alarm box is placed in service.

4.3 The representative from the installing company must be present to conduct the acceptance testing.

Note to installers: These guidelines are subject to change; please check with the Onset Fire Department to make sure there have been no updates.

END OF SECTION

SECTION 31 0130
EARTHWORK

PART 1 — GENERAL

1.01 DESCRIPTION

- A. Provide facilities, labor, materials, tools, equipment, appliances, transportation, supervision, and related work necessary to complete the work specified in this Section, and as shown on the Drawings.
- B. The work of this Section includes but is not necessarily limited to:
 - 1. Excavation, fill, and backfill, including compaction as indicated or required, to the lines and grades indicated on the Drawings.
 - 2. Excavation and disposal of unsuitable or excess materials off-site, unless other on-site locations are allowed. Excavation shall include removal and satisfactory disposal of all unclassified material encountered throughout the site.
 - 3. Rough grading, including placement, moisture conditioning and compaction of fills and backfills.
 - 4. Placement of base and subbase course materials under structures, slabs and footings, including compaction. Placement of base and subbase course materials under pavement is located under Section 32 11 10 – Pavement Subbase and Base.
 - 5. The removal, hauling and stockpiling of suitable excavated materials for subsequent use in the work. Stockpiling shall include protection to maintain materials in a workable condition at no additional cost to the owner.
 - 6. Rehandling, hauling and placing of stockpiled materials for use in refilling, filling, backfilling, grading and such other operations at no additional cost to the owner.
 - 7. Protection of existing buildings, pavements, and utilities to remain at no additional cost to the owner.
 - 8. Furnishing and installing all sheeting, shoring, and bracing of structural and trench excavations at no additional cost to the owner.
 - 10. Providing products in sufficient quantities to meet the project requirements.
 - 11. Securing all required permits, licenses, and approvals of appropriate municipal and utility authorities, prior to commencing the work of this Section. The Contractor shall pay for all licenses and other fees required for proper execution of the Work. The Owner shall pay for any and all permits. Refer to General Conditions of the Contract for Construction for additional details.
- C. Contractor shall be responsible for notifying all owners of affected utilities and for contacting Dig Safe at least 72 hours prior to excavation.

1.02 RELATED SECTIONS

- A. Carefully examine all of the Contract Documents for requirements which affect the work in this Section. Other specification sections which directly relate to the work of this Section include, but are not limited to, the following:
 - 1. Section 01 2100 – Allowances
 - 2. Section 31 2510 – Erosion and Sedimentation Control
 - 3. Section 31 1216 – Bituminous Concrete Pavement
 - 4. Section 32 1217 – Bituminous Concrete Sidewalks
 - 5. Section 32 9200 – Seeding and Sodding

1.03 DEFINITIONS

- A. Unacceptable material is soil material that contains organic silt, peat, vegetation, wood or roots, stones or rock fragments over 6 inches in diameter or exceeding 40 percent by weight of the backfill material, porous biodegradable matter, loose or soft fill, construction debris, or refuse, or material which cannot be compacted to the specified or indicated density. Percentage of rock shall be determined by the Contractor's independent testing laboratory. Acceptable material is material that is not "unacceptable material", classified is as defined herein.
- B. Surplus material is excavated acceptable material that cannot be utilized elsewhere on the site as backfill or embankment fill, or as otherwise directed by the Engineer.

1.04 EXCAVATION CLASSIFICATIONS

- A. Excavation: Excavation shall be unclassified and no consideration will be given to the nature of the materials, with the exception of rock and hazardous materials. Excavation shall comprise and include the satisfactory removal and disposal of all materials encountered regardless of the nature of the materials and shall be understood to include, but not limited to, earth, fill, foundations, pavements, curbs, piping, railroad track and ties, cobblestones, footings, bricks, concrete, previously abandoned drainage structures and utility structures abandoned and not removed by the utility and debris.
- B. Rock Excavation: Rock is defined for payment purposes as stone or hard shale in original ledge, boulders over two cubic yards (2yd³) in volume in open areas and one cubic yard (1yd³) in volume in trenches, and masonry or concrete that cannot be broken or removed by normal job equipment (power shovels, scoops, or D-8 bulldozers with ripper attachment) without the use of explosives or drills. The classification does not include materials that can be removed by means other than drilling and blasting or drilling and wedging but which, for reasons of economy in excavating, the Contractor prefers to remove by drilling and blasting. The word "trenches" shall mean excavation having vertical sides the depths of which exceed the width, made for drain, sewer, water, and gas pipes; electric and steam conduits; and the like.
- C. Hazardous Waste
 1. The Contractor shall be familiar with the State Department of Environmental Protection (DEP) Hazardous Waste Regulations 310 CMR 30.00 and the Massachusetts Contingency Plan (MCP) 310 CMP 40.00 when conducting earthwork operations.
 2. In general, a hazardous waste (contaminated with oil or hazardous materials) is a waste or combination of wastes which, because of its quantity, concentration or physical, chemical or infectious characteristics, may cause, or significantly contribute to, an increase in mortality or an increase in serious irreversible or incapacitating reversible illness or pose a substantial present or potential hazard to human health, safety, or welfare, or to the environment when improperly stored, treated, transported, or disposed of, or otherwise managed. (Additional criteria and characteristics to determine if a waste is hazardous are contained in 310 CMR 30.111, 30.112 and 30.120 through 30.125).

1.05 LAWS AND REGULATIONS

- A. Work shall be accomplished in accordance with federal state and local laws and regulations of local, county and state agencies and national or utility company standards as they apply.

1.06 QUALITY ASSURANCE

- A. Through the Engineer the Owner may retain and pay for the services of a Geotechnical Consultant to perform on-site observation and testing during the following phases of the construction operations. The scope of services will be determined by the

Architect/Engineer and Owner and the Geotechnical Consultant. The Owner reserves the right to modify or waive Geotechnical Consultant services.

- B. The Geotechnical Consultant's presence does not include supervision or direction of the actual work by the Contractor, his employees or agents. Neither the presence of the Geotechnical Consultant, nor any observations and testing performed by him, nor any notice of failure to give notice shall excuse the Contractor from defects discovered in his work.
- C. Costs related to retesting due to failures shall be paid for by the Contractor at no additional expense to Owner. The Contractor will pay for all additional costs for re-testing.

1.07 SUBMITTALS

- A. Submit an analysis of each type of off-site fill and aggregate materials that are to be used at the site, a minimum of one week prior to delivery to the site. Use of these proposed materials by the Contractor prior to testing and approval or rejection shall be at the Contractor's risk.
- B. The Engineer will be responsible for the approval or rejection of the suitability of all materials.
- C. Submit the name of each material supplier and specific type and source of each material. Any change in source throughout the job requires approval of the Engineer.
- D. For use of fabrics or geogrids, submit manufacturer's literature for approval by the Engineer.

1.08 COORDINATION

- A. Prior to start of earthwork the Contractor shall arrange an on-site meeting with the Engineer for the purpose of establishing the Contractor's schedule of operations and scheduling observation and testing procedures and requirements.
- B. As construction proceeds, the Contractor shall be responsible for notifying the Engineer prior to the start of earthwork operations requiring observation and/or testing.

1.09 TOLERANCES

- A. Construct finished non-paved surfaces to plus or minus 1 inch of the elevations indicated. Complete embankment slopes to plus or minus six horizontal inches of the slope line (toe or tip) shown. Maintain the moisture content of fill materials as it is being placed within plus or minus two percent of the optimum moisture content of the material as determined by the laboratory tests herein specified.

1.10 APPROVALS

- A. No earthwork materials will be accepted on the jobsite without written approval from the Engineer

1.11 OTHER SPECIFICATIONS

- A. The requirements of the Massachusetts Department of Transportation Standard Specification for Highways and Bridges (MDTSSHB), Onset Fire District Water Department, Town of Wareham Sewer Department, and Town of Wareham Municipal Maintenance Highway Department are also made part of these Specifications.

PART 2 — PRODUCTS

2.01 MATERIALS

- A. Gravel Borrow shall conform to MDTSSHB Section M1.03.0, Type c.
- B. Topsoil shall conform to Specification Section 32 92 00 Seeding and Sodding.
- C. Common Fill/Ordinary Borrow shall conform to MDTSSHB Specification Section M1.01.0.
- D. Crushed Stone shall conform to MDTSSHB Specification Section M2.01.1.

- E. Processed Gravel Base shall conform to MDTSSHB Specification Section M1.03.1.
- F. Double Washed Crushed Stone shall conform to MDTSSHB Specification Section M1.01.0 and shall be double washed.
- G. Stone Dust shall conform to MDTSSHB Specification Section M2.05.0.
- H. Sand shall conform to MDTSSHB Specification Section 1.04.0 Type b.

PART 3 — EXECUTION

3.01 GENERAL REQUIREMENTS

- A. The Contractor shall control the grading so that ground is pitched to prevent water from running to excavated areas, eroding slopes, damaging other structures, or adjacent properties. Refer to Section 31 25 10 – Erosion and Sedimentation Control.
- B. Control dust during the course of the contract in accordance with Section 31 25 11 – Temporary Dust Control.
- C. Construction Traffic Disperse travel paths of traffic and construction equipment over entire width of compacted surfaces to aid in obtaining uniform compaction. Protect exposed soil layers with high moisture content from excessive wheel loads.
- D. Use of Materials Found of Site
 - 1. Suitable excavated materials shall be used for embankment, backfill, or any other purpose as directed and the material shall be placed and compacted in a manner conforming to the specifications for the particular type of work required at no additional cost to the Owner.
 - 2. Suitable material that cannot be readily placed shall be stockpiled at the jobsite in an area designated by the Engineer and used in the manner and purpose described above or removed from the site. All work necessary to stockpile and re-handle suitable material will be at no additional cost to the Owner and will be included in the Contract price. If the Contractor desires to store suitable material off the jobsite, or remove suitable material from the jobsite, written permission shall be obtained from the Engineer.
 - 3. No excess soil is to be removed from the site unless approved by the Engineer. All excess material is to be used on site at the direction of the Engineer at no additional cost to the owner.
 - 4. Do not excavate or remove any material from within the site which is not within the excavation, as indicated, without written authorization from the Engineer.
- F. Salvaging Topsoil Salvage topsoil within the neat lines as indicated, or as otherwise designated by the Engineer, and stockpile at the jobsite at locations approved by the Engineer. Prevent topsoil from contamination by other materials, and provide adequate drainage and erosion protection. Clear, grub, and rough-grade storage areas so that the maximum amount of stockpiled material will be available for reuse. .
- G. Stockpiling of Excavated Material Establish excavated material stockpiles on site only in locations where they will not interfere with the progress of the work and only as approved by the Engineer.
- H. Surplus and/or Unsuitable Material Stockpile and dispose of excavated materials which are in excess and/or are determined to be unsuitable for topsoil, embankment and backfill, at no additional expense to the Owner. The Contractor shall assume that the material is urban fill and meets the criteria for disposal in lined or unlined Massachusetts landfills. When approved by the Engineer, such material may be disposed of at designated locations within the site. Offsite disposal facilities and any soil testing associated with offsite disposal must be approved by the Engineer.

- I. Unfavorable Weather Do not place, spread, roll or compact fill material that is frozen or thawing, or during unfavorable weather conditions. If interrupted by heavy rain or other unfavorable conditions, do not resume until ascertaining that the moisture content and density of the previously placed soil are as specified.
- J. Maintenance of Excavation, Slopes and Embankments.
 - 1. Excavate and remove material outside the limits of excavation which in the opinion of the Engineer, is unsuitable and constitutes potential slides, and material which comes into excavations for any reason including the driving of piles therein.
 - 2. Maintain slopes and embankments until final completion and acceptance of the work. Promptly repair slides, slipouts, washouts, settlements, and subsidence which occur for any reason, and refinish the slope or embankment to the original lines and grades or as required by the Engineer.
 - 3. Provide earth retention systems as required by federal, state and local regulations. Shoring and bracing of trenches and other excavations shall be in accordance with the latest OSHA Standards and Interpretation, Subpart P – Trenches and Shoring, and to all other applicable codes, rules and regulations of the federal, state and local authorities.
- K. Hazardous Material:
 - 1. The Contractor shall immediately halt soil movement activities and notify the Architect/Engineer and Owner if visual, olfactory or other evidence suggests that soils are contaminated with oil or hazardous materials.
 - 2. Any contaminated soils shall be managed and handled in compliance with the referenced state/federal regulations, guidelines and policies.

3.02 OBSTRUCTIONS NOT INDICATED AND NOT VISIBLE

- A. All available information was used to establish the location of pipes, drains, structures, and utilities, as shown on the Drawings. However, accuracy and completeness of such drawings cannot be guaranteed. Therefore, if the Contractor encounters such items within the indicated limits of excavation, which will be damaged if work is to continue or which will cause delays, notify the Engineer immediately so the obstruction can be addressed and documented for payment, as authorized by the Owner.

3.03 GENERAL EXCAVATION REQUIREMENTS

- A. Excavate to the lines and grades indicated. Exercise care to preserve the material below and beyond the lines of excavation. Where excavation is carried out, through error, below indicated grade or beyond the lines of excavation, backfill to the indicated grade and compact with approved fill at no additional cost to the Owner, and at the direction of the Engineer.
- B. Limits of the excavation shall allow for adequate working space for installing forms and as required for safety of personnel. Cut excavations in solid rock accurately to the neat lines indicated, or, if not indicated, to the width of the trench.
- C. Excavation for the convenience of the Contractor shall conform to the limits acceptable to the Engineer and shall be at no additional cost to the Owner. Contractor shall not over excavate below proposed design grades for the purpose of obtaining borrow for use off-site.
- D. When any excavation is extended beyond the limits indicated, backfill and compact the additional excavated area with material indicated to be under the pipe, conduit, or structure which was being excavated for, at no additional cost to the Owner.

- E. Limit the length of trench open at any one time as to eliminate interference with traffic and the operations of others and to reduce conditions dangerous to personnel, equipment and existing site improvements, all according to site conditions.
- F. Excavate by use of hand tools when within 2 feet of existing pipes, conduits, or other structures.

3.04 TRENCH EXCAVATION

- A. In general, trenches shall be excavated to such depth as will provide a cover depth as indicated on the Drawings from finished grade to the top of the pipe barrel. Deeper trenches shall be provided where necessary on account of the conformation of the ground and to permit the alignment of the pipe without undue deflection of joints.
- B. Trenches shall be excavated by hand or machinery to the width and depth indicated on the Drawings and specified herein. Depth shall account for thickness of the pipe and thickness of bedding. All loose materials shall be removed from the bottom of the trench so that the bottom of the trench will be in an undisturbed condition.
- C. If in the opinion of Engineer, the material at or below the depth to which excavation for structures and pipes would normally be carried is unsuitable for foundation, it shall be removed to such widths and depths as directed and replaced with suitable material.
- D. Trench widths shall be 3 feet greater than the nominal inside diameter of pipe for such diameters of 36 inches or less. For diameters greater than 36 inches, the width shall be 4 feet greater than nominal inside diameter. Trench excavation for manholes, catch basins, drop inlets, etc. shall be two (2) feet outside the neat lines of the foundations. These limits may be adjusted for field conditions at the direction of Engineer.
- E. Bedding for pipe and utility structures will be as detailed on the Drawings.

3.05 ROCK EXCAVATION

- A. Cross Sectioning: When rock is encountered during excavation, it shall be uncovered and exposed, and the Engineer shall be notified in writing by the Contractor before blasting work proceeds. The areas in question shall then be measured, and payment shall be determined. Excavation of material in question before agreement by the Engineer as to the character of the material, or failure to notify the Engineer or to take measurements will forfeit the Contractor's right to payment for rock excavation. The quantity of rock to be removed shall be based on the limits established below. Measurements shall be made by a Registered Surveyor, paid for by the Contractor, and approved by the Engineer.
- B. Measurement: Excavation of rock, as defined in paragraph 1.05A, if ordered in writing by the Engineer with the prior written approval of the Owner, measured in place within the Contract limits as defined on the Plans or in any duly authorized modifications thereto. Measurement for rock excavation will be made for:
 - 1. Foundations within the limits of the concrete lines as defined by the working plans or by duly authorized modifications thereto, plus twelve inches (12") outside the vertical concrete lines and twelve inches (12") below base.
 - 2. Pipe trenches to a depth of six inches (6") below the bottom of the bell and for a width equal to the inside diameter of the pipe, plus fifteen inches (15") beyond the inside diameter on each side, provided that overlapping computed volumes of any ledge or boulder excavation shall be paid for only once.
 - 3. Paved areas to the underside of the respective subbase for such areas.
 - 4. Lawns and planting areas to a depth of twenty-four (24") below finished grade.
 - 5. Any foreseen rock or boulder encountered, which must be removed for construction of the work defined on the plans or in modification thereto, shall be

measured in its original position to the limits of clearly defined vertical construction lines and to the depth required for the defined construction; payment will be at the unit prices stated above.

C. Blasting:

1. The Driller and Geotechnical Engineer shall log the bottom elevation of all drill holes made for blasting within the building area.
2. No blasting shall be done without the Engineer's approval. Written permission and approval of methods must be obtained from the local government authority.
3. Contractor shall, before doing any blasting work, present to the Engineer written certificate of insurance showing evidence that his insurance includes coverage for blasting operations.
4. Experienced powerment or persons who are licensed or otherwise authorized to use explosives shall do blasting. Accurate records shall be maintained, noting location of each blast, time of detonation, total explosive weight in each blast, maximum explosive weight per delay in each blast hole, and designation of delay cap used in each hole.
5. Explosives shall be stored, handled, and employed in accordance with state and local regulations, or, in the absence of such, in accordance with the provisions of the Manual of Accident Prevention in Construction of the Associated General Contractors of America, Inc. and in accordance with applicable OSHA regulations.
6. The amount of vibration and airblast overpressure generated by blasting shall not exceed regulatory statutes or directives established by state, local or other governing authorities, such as but not limited to, 527 CMR 13.091. In no case shall the maximum Peak Particle Velocity (PPV) exceed the limits indicated on figure B-1, Appendix B, of the United State Bureau of Mines Report of Investigations, RI8507, 1980 (copy attached). These limits shall apply at all existing and under construction structures, utilities as well as at property and construction limits. (The Engineer may designate lower levels at sensitive structures.)
7. Contractor shall take great care to do no damage to existing buildings, foundations, glazing and trees to remain. All damage caused by Contractor's blasting operations shall be repaired to the full satisfaction of the Engineer at no additional cost to the Owner.

3.06 UNACCEPTABLE SUBGRADE

- A. If unacceptable material (defined in paragraph 1.03A) is encountered below or at the subgrade which excavation was indicated to be taken to, remove such materials and dispose of it as specified herein. Limits of removal shall be as directed by the Engineer. After removal of unsuitable materials, backfill with crushed stone or gravel borrow, and compact to specified density requirements. For such work not caused by the Contractor's operations or lack of surface drainage control, the Contractor shall be paid as Extra Work, as approved by the Architect/Engineer and Owner.
- B. Where subgrade has been softened or eroded by flooding, equipment traffic or placement during unfavorable weather, it shall be considered "unacceptable material" and handled in accordance with paragraph A above, at no additional cost to the Owner.

3.07 SUBGRADE PREPARATION AND PROTECTION

- A. General Requirements

All subgrade areas shall be made ready for fill by removal of all organic material, topsoil, loose fill, unsuitable soils and deleterious materials, as directed by the Engineer.

B. Proof Rolling Subgrades

Prior to placement of fill, proof roll natural ground above groundwater levels by making a minimum of two passes with approved compaction equipment.

C. Deep Compaction (In areas of loose fill where applicable)

D. Rock Subgrades

1. Subgrades outside building area may have a maximum 2-foot zone of overblast rock provided that:
 - a. Loose rock is covered with suitable layer of crushed stone or choke stone; and
 - b. Prior to placing crushed stone or choke stone, the area is rolled with at least four passes of a heavy vibratory roller.
2. Bottom of rock excavations for support of foundations shall be cleaned of all loose materials.
3. Rock surface for footings shall have a maximum slope of 4 horizontal to 1 vertical.
4. Rock excavations for footings carried below design grades shall be backfilled by placement of concrete with same strength as footing at the Contractor's cost. At the discretion of the structural engineer, footings could be dropped below design elevation onto competent rock.

3.08 PLACEMENT AND COMPACTION OF MATERIALS

A. General Requirements

1. The soils testing laboratory will determine the optimum moisture content to achieve the maximum dry density for all soils specified or indicated to be compacted to a percentage of its maximum dry density.
2. Unless other material is indicated or specified, place excavated acceptable material for backfilling trenches and around structures and filling for embankments. The composition of these materials and tests performed to determine moisture-density relationships will govern both their acceptability for backfill and method best suited for their placement and compaction. If sufficient excavated acceptable material is not available from the excavations, provide backfill material of ordinary borrow, or as otherwise directed by the Engineer.
3. Provide adequate pumping and drainage facilities to keep the excavation area dry from groundwater and/or surface runoff so that it does not adversely affect construction procedures or cause excessive disturbance of underlying natural ground.
4. Compaction by puddling or jetting is prohibited.
5. Protect fill area by grading to drain and providing a smooth surface, which will readily shed water. Grade the surface of the areas in such a manner as to prevent ponding of surface runoff water in areas to receive compacted fill.
6. Do not place frozen fill. Do not place fill on frozen ground.
7. Placement of fill shall not begin prior to observation and approval of subgrade conditions by Engineer.

8. To the extent that is practicable, each layer of fill shall be compacted to the specified density the same day it is placed. Fill shall be placed in horizontal layers. Where the horizontal layer meets a natural rising slope, the layer shall be keyed into the slope by cutting a bench during spreading of preceding lift.
9. Prior to backfilling between foundation wall and excavation limits, remove unsuitable material, including rubbish, organic materials or other debris.
10. Do not commence filling operations until Engineer and/or Architect have observed conditions.
11. Protect foundations, footings, foundation waterproofing, and site utilities during backfilling. Repair damage at no cost to Owner.
12. Backfill shall not be placed against masonry, concrete or walls until they are braced or have cured sufficiently to develop strength necessary to withstand, without damage, pressure from backfilling and compacting operations.
13. Provide shoring, sheeting, and/or bracing of excavations as required to assure complete safety against collapse of the earth at the side of excavations. Alternatively, lay back excavations to a stable slope.
14. Upon completion of the work, the final ground surface shall be left in a firm, unyielding, true, uniform condition, free from ruts. Repair disturbed areas caused by equipment traffic at no cost to Owner.

B. Equipment

1. Compaction equipment used in open areas where space permits shall consist of vibratory rollers weighing at least 10,000 pounds.
2. Compaction equipment for fill against foundation walls and in other confined areas shall be accomplished by means of drum-type, power-driven, or by hand-guided vibratory plate compactors.

C. Compaction

1. Compaction Requirements

- a. The degree of compaction is expressed as a percentage of the maximum dry density at optimum moisture content as determined by ASTM Test D1557, Method C. The compaction requirements are as follows:

Area	Minimum Degree of Compaction
Pavement base and subbase courses	95%
General fill below pavement subbase	95%
Trench backfill (inside bldg.)	95%
Trench backfill (outside bldg.):	
- Below pipe to spring line	95%
- Spring line to 1 ft. above pipe	95%
- 1 ft. above pipe to pavement subbase or finish grade	95%
Landscape areas	90%

Compactions percentages are based on the laboratory derived Maximum Density values.

2. Moisture Control
 - a. Discontinue backfilling and compaction from November to April (wet season) unless the Contractor demonstrates successful moisture and compaction control techniques to achieve the indicated or specified density requirements.
 - b. Fill material that is too wet for proper compaction shall be harrowed, or otherwise dried to a proper moisture content to allow compaction to the required density. If fill cannot be dried within 24 hours of placement, it shall be removed and replaced with drier fill at his expense.
 - c. Fill material that is too dry for proper compaction shall receive water uniformly applied over the surface of the loose layer. Sufficient water shall be applied until the optimum moisture content is reached, as determined by the soil testing laboratory, as specified in paragraph 3.09.A.1.
 - d. In no case shall fill be placed over material that is frozen. No fill material shall be placed, spread or rolled during unfavorable weather conditions. When work is interrupted by heavy rains, fill operations shall not be resumed until the moisture content and the density of the previously placed fill are as specified.
 - e. The Contractor shall continue to compact until the indicated or specified density requirements are achieved.
3. Placement and Lift Thickness of Material

Distribute material such that stones and lumps do not become nested, causing voids between stones. Distribute such that voids are completely filled with fine materials regardless of compaction method.

Deposit and spread material in uniform parallel layers not to exceed 12 inches (12") in thickness when utilizing heavy compaction equipment, and 6 inches (6") when utilizing light hand-operated compaction equipment.

3.09 OBSERVATION AND TESTING

- A. The Owner may retain a Geotechnical Consultant to perform on-site observation and testing during the earthwork phase of the construction operations. The Contractor shall allow the Geotechnical Consultant sufficient time to make necessary observations and tests. The services of Geotechnical Consultant shall include, but not be limited to, the following:
 1. Observation during excavation and dewatering of building and controlled fill areas.
 2. Observation during backfilling and compacting operations within that area defined as building area or controlled fill area and other areas as appropriate.
 3. Laboratory testing and analysis of fill materials specified, as required or the testing of excess soils generated during the course of the work.
 4. Observation of construction and performance of water content, gradation and compaction tests at a frequency and locations that he shall select. The results of these tests will be submitted to the Owner, on a timely basis so that action can be taken to remedy indicated deficiencies. During the course of construction, the Geotechnical Consultant will advise the Owner in writing if at any time in his opinion or failure to give notice, shall excuse the Contractor from defects discovered in his work.

3.10 DISPOSAL OF SURPLUS, UNACCEPTABLE OR HAZARDOUS MATERIAL

- A. No excavated material shall be removed from the site or disposed of by the Contractor unless approved by the Engineer.
- B. Surplus excavated acceptable materials (as defined in paragraph 1.03B) shall be used to backfill normal excavations in rock or to replace other materials unacceptable for use as backfill or as otherwise directed by the Engineer. Upon written approval of the Engineer, surplus excavated materials shall be neatly deposited and graded so as to make or widen fills, flatten side slopes, or fill depressions; or shall be neatly deposited for other purposes as indicated by the Architect/Engineer and Owner, within its jurisdictional limits; all at no additional cost to the Owner.
- C. Surplus excavated material not needed as specified above shall be hauled away and disposed of by the Contractor at no additional cost to the Owner.
- D. Disposal of all unacceptable, surplus, and hazardous materials shall be in accordance with all applicable local, state and federal regulations.

END OF SECTION 31 0130

SECTION 31 2510
EROSION AND SEDIMENTATION CONTROL

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions, are hereby made a part of this Section.

1.02 SUMMARY

- A. This Section specifies requirements for temporary erosion and sedimentation control (ESC) provisions.
- B. The work includes:
1. Providing all temporary erosion control measures as required during the life of the Contract to control soil erosion and water pollution.
 2. The installation and maintenance of silt fence, berms, ditches, sedimentation basins, construction exits, fiber mats, catch basin filters, straw, netting, gravel, trenches, mulches, grasses, slope drains and other approved erosion control devices or methods.
- C. Related Work: The following Sections contain work related to this Section:
1. Section 02 41 14 – Site Preparation
 2. Section 31 01 30 – Earthwork
 3. Section 31 25 11 – Temporary Dust Control

1.03 SUBMITTALS

- A. Prior to the start of the construction, the Contractor shall submit to the Engineer for acceptance, schedules for the construction of required stormwater detention basins, temporary and permanent erosion and sedimentation control work, clearing and grubbing, grading, structures at watercourses, construction, and paving. No work shall be started until control schedules and methods of operations have been accepted by the Engineer.

1.04 REFERENCES

- A. Massachusetts Department of Transportation Standard Specification for Highways and Bridge (MDTSSHB), and the rules and regulations for the Town of Wareham.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Erosion Seed for quick growing grasses, such as wheat, rye or oats, shall be in accordance with MDTSSHB Section M6.03.1 Erosion Seed.
- B. Hay bales shall be individually banded with twine (nylon or other synthetic material is not acceptable) a minimum of two bands for bale, approximately two feet six inches (2'-6") in length. Stakes for hay bales shall be standard two inch by two inch (1"x1") wood stakes or approved equivalent.
- C. Silt fence fabric shall be 100X, as manufactured by Mirafi, or approved equal.
- D. Filter fabric at construction entrance shall be 600X, as manufactured by Mirafi, or approved equal.
- E. Catch Basin Filters shall be "Silt Sak" by Jennian, "Dandy Bag" by Dandy Products, "Drain Pac" by United Storm Water Inc., or approved equivalent.

PART 3 - EXECUTION

3.01 GENERAL

- A. Erosion and sediment controls shall be in placed prior to any soil disturbing activities including, but not limited to, clearing and grubbing, earthwork, dewatering, and excavation work.
- B. All disturbed soils shall be stabilized, either permanently or temporarily, within two (2) weeks of disturbance.
- C. At a minimum, the following shall apply:
 - 1. Staked bales of hay shall be provided at low points where drainage from the work leaves the site to filter the sediment out of the water. Sufficient bales of hay shall be provided such that all flow will filter through the hay. Other methods which reduce the sediment content to an equal or greater degree may be used as approved by the Engineer.
 - 2. Drainage leaving the site shall flow to water courses in such a manner as to prevent erosion.
 - 3. Loaming and seeding or mulching areas shall take place as soon after the work as practicable.
- D. When it becomes necessary, the Engineer will inform the Contractor of construction procedures and operations that jeopardize erosion control provisions. If these construction procedures and operations are not corrected promptly, the Engineer may suspend the performance of any or all construction activities until corrections have been made, and such suspension shall not be the basis of any claim by the Contractor for additional compensation from the Owner nor for an extension of time to complete the Work.
- E. The Engineer has the authority to order immediate, additional, temporary control measures to prevent contamination of adjacent streams or other watercourses, or other areas of water impoundment and damage by erosion at no additional cost to the owner.
- F. The Contractor shall construct all permanent erosion and sediment control features at the earliest practical time as outlined in the accepted schedule. Temporary erosion and sediment control measures shall be used to correct conditions that develop during construction which were unforeseen, but are needed prior to installation of permanent control features, or that are needed temporarily to control erosion or sedimentation which develops during construction operations.
- G. Where erosion is likely to be a problem, clearing and grubbing operations shall be scheduled and performed so that grading operations and permanent erosion and sediment control features can follow immediately thereafter, if conditions permit; otherwise, temporary control measures will be required between successive construction stages.
- H. Failure by the Contractor to control erosion, pollution, and siltation shall be cause for the Owner to employ outside assistance to provide the necessary corrective measures. The cost of such assistance, including engineering costs, will be charged to the Contractor and appropriate deductions made to the Contractor's monthly progress payment request.
- I. Temporary and permanent erosion and sedimentation control measures are shown on the Drawings. The Contractor shall strictly adhere to the provisions. Additionally, temporary measures shall be constructed to accommodate field conditions that develop during construction.

- J. Temporary sedimentation traps or basins shall be employed as required during construction. The Contractor shall direct all possible site runoff to the temporary sedimentation basins.
- K. The temporary sedimentation basins shall be maintained from the start of construction until construction of the permanent detention basins is completed and perimeter areas are stabilized. A temporary outlet shall be constructed above the expected sediment levels. Construction of the basins shall be sequenced so that the temporary outlet is installed and basin embankment is constructed with the material available from the initial site excavations.

3.02 HAY BALES

- A. Hay bales shall be installed at the following locations, as required by the Engineer and as shown on the Drawings:
 - 1. Toe of slope of embankment construction to filter all runoff flowing off-site.
 - 2. Toe of temporary earthwork stockpile slopes.
 - 3. Across construction ditch prior to entry into drainage system or waterway.
 - 4. Around the perimeter of drainage inlets.
- B. Tightly abut hay bales to form a continuous barrier. Secure bales in place with two stakes per bale. The bales shall be trenched four inches (4") into the ground, unless directed otherwise by the Engineer.

3.03 SILT FENCE

- A. Silt fence shall be installed as shown on the Drawings.
- B. Supporting posts shall be spaced four feet (4') on center, and driven at least two feet into the ground. Posts shall be two-inch (1") square or heavier wood posts, or standard steel posts.
- C. Fabric shall be anchored in a four-inch (4") deep trench dug on the upslope side of the posts. The trench shall be at least six inches (6") wide. The fabric shall be laid in the trench, backfilled and compacted.
- D. Fabric rolls shall be spliced at posts. The fabric shall be overlapped 6 inches, folded over and securely fastened to posts.

3.04 MAINTENANCE AND CLEAN UP

- A. The Contractor shall inspect erosion control devices weekly, immediately after each storm event and daily during prolonged rainfall and maintain them in good operating condition for the life of the contract. Hay bales shall be replaced when deteriorated, rotted or destroyed, and as directed by the Engineer.
- B. The Contractor shall inspect the condition of diversion dikes and ditches, filter berms, interceptor dikes, sediment basins and other erosion and sedimentation control devices after each rainstorm and during major storm events. Repairs shall be made as necessary and as directed by the Engineer.
- C. Accumulated sediment trapped by erosion and sedimentation control devices shall be removed as follows or as otherwise directed by the Engineer:
 - 1. Silt fences: remove sediment buildup if greater than four (4) inches deep.
 - 2. Sedimentation traps: remove sediment buildup if greater than ½ the depth of the trap

3. Silt sacks: remove sediment buildup if greater than two (2) inches deep or if sediment is preventing flow from entering basin; replace sacks if they are torn or have been punctured
 4. Haybales: remove sediment buildup if greater than ½ the height of the haybale
- D. During construction, temporary outlets of the drainage systems shall direct the flow to temporary or permanent sedimentation basins.
- E. Temporary soil erosion and sedimentation control devices shall be removed and adjacent areas outside the limits of grading restored upon completion of the work or when directed by the Engineer. Upon removal of the temporary controls, the site shall be restored to original condition.

END OF SECTION 31 2510

**SECTION 31 2511
TEMPORARY DUST CONTROL**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Furnishing and spreading water, calcium chloride, and/or mulch on the subgrade, or in other areas of a Project Site or associated off-site areas, for the purpose of controlling dust emissions.
- B. The requirements set forth in this Section of the specifications apply to all phases and areas of construction.
- C. Contractor is responsible for all health and safety.

1.2 REFERENCES

- A. Reference herein to any technical society, organization, group or regulation are made in accordance with the following abbreviations and, unless otherwise noted or specified, all work under this Section shall conform to the latest edition as applicable.
- B. Requirements of the Commonwealth of Massachusetts Department of Environmental Protection
 - 1. 310 CMR 7.09: Air Pollution Control Regulations.
- C. American Society for Testing and Materials (ASTM)
 - 1. ASTM D98, Standard Specification for Calcium Chloride.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Only water, calcium chloride, and mulch are approved for dust control. No asphalt or petroleum-based products may be utilized for dust control.
- B. Water used shall be clean, non-polluted water obtained from sources approved by Engineer.
- C. Calcium chloride, ASTM D98. Calcium chloride in pellet form and flake form shall be acceptable.
 - 1. Calcium chloride shall be packaged in moisture proof bags or in airtight drums with the manufacturer, name of product, net weight, and percentage of calcium chloride guaranteed by the manufacturer legibly marked on each container.
 - 2. Engineer may reject calcium chloride failing to meet the requirements of the aforementioned specifications or which has become caked or sticky in shipment.
- D. Mulch
 - 1. Straw mulch: Threshold straw of oats, wheat, barely, or rye that is free from noxious weeds, mold or other objectionable material. Straw mulch shall contain at least 50 percent by weight of material to be 10-in or longer.
 - 2. Wood chips: Processed tree trimmings free of trash or other physical contaminants such as metal and plastic.

PART 3 EXECUTION

3.1 GENERAL

- A. Dust control shall be the responsibility of Contractor and dust control operations shall meet the requirements of the Massachusetts Department of Environmental Protection.
- B. Construction sequencing shall be organized and conducted in a manner to leave existing pavement or ground coverings in place until just prior to earth excavation for the purpose of minimizing the migration of dust beyond the Project Limits into the surrounding area.

- C. Engineer reserves the right to conduct active dust monitoring using visual methods and may utilize particulate measurement equipment during the course of the work. If the amount of fugitive dust and/or particulate generated during the work is deemed unacceptable in the Engineer's judgment or exceeds baseline Project Site conditions at Engineer's monitoring locations, Engineer may require Contractor to stop work and implement corrective measures. No claim for delay will be considered for work stoppage based upon the results of Engineer's active dust monitoring results.
- D. Stockpiled materials from which particle have the potential of becoming airborne shall be securely covered with a temporary waterproof covering made of polyethylene, polypropylene, hypalon, or approved equal. The covers must be in place at all times when work with the stockpiles is not occurring.
- E. Subcontractor shall sweep all adjacent roads and neighboring parking lots and driveways that are impacted by the work. Whenever dirt is tracked from the site it shall be cleaned as necessary to prevent it from becoming a nuisance or hazard. At minimum, adjacent streets shall be swept once per week.

3.2 WATER

- A. The application of water shall be under the control of Engineer at all times. It shall be applied only at the locations, and at such times, and in the amount as may be directed by Engineer. Quantities of water wasted or applied without authorization will not be paid for.
- B. Use of water will not be permitted when it will result in, or create, hazardous or objectionable conditions such as ice, flooding or pollution.
- C. Contractor shall have available and maintain in an operable condition at all times, sufficient equipment for the purpose of applying water for dust control.
- D. Watering equipment shall consist of pipelines, tanks, tank trucks, distributors, pumps, meters, hose or other devices, approved by Engineer, which are capable of applying a uniform spread of water over the surface. A suitable device for a positive shut-off and for regulating the flow of water shall be located so as to permit positive operator control.
- E. Applications of water for dust suppression include, but are not necessarily limited to, the following:
 - 1. Demolition activities, material handling, material processing, and loading.
 - 2. Earthwork.
 - 3. Open excavation faces and dust-prone areas of the work.
 - 4. Temporary access roads and roadway surfaces within and around the Project Site.

3.3 CALCIUM CHLORIDE

- A. Calcium chloride shall be applied only at the locations, at such times and in the amount as may be directed by the Engineer and only in areas that will not be adversely affected by the application.
- B. Calcium chloride shall be uniformly applied at the rate of one and one-half (1 ½) pounds per square yard (lb/yd²) or at any other rate as directed by Engineer. Application shall be by means of a mechanical spreader, or other approved methods. The number and frequency of applications shall be to Engineer's satisfaction.

3.4 MULCH FOR DUST CONTROL

- A. Coordinate the use of mulch for dust control with erosion and sedimentation control measures.
- B. Straw mulch shall be applied at a rate of 100 pounds per 1,000 square feet (100 lb/1,000 ft²).
- C. Wood chips or wood mulch shall be applied at such a rate as to form a layer one (1) inch thick.

3.5 OTHER DUST CONTROL MEASURES

- A. A temporary seed mixture may be spread in lieu of, or in addition to mulch over areas where the suspension of grading work in disturbed areas is expected to be more than 30 calendar days and as directed by Engineer.

END OF SECTION 31 2511

**SECTION 32 1110
PAVEMENT SUBBASE AND BASE**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions, are hereby made a part of this Section.

1.02 SUMMARY

- A. This Section specifies requirements for the preparation for and placement of granular pavement subbase and base materials.
- B. The work includes:
 - 1. Fine grading and compaction of pavement subgrade.
 - 2. Furnishing, placing and compacting of subbase and base materials.
- C. Related Work: The following Sections contain work related to this Section:
 - 1. Section 31 0130 Earthwork
 - 2. Section 32 1216 Bituminous Concrete Pavement
- D. Work in this Section shall conform to the requirements of Massachusetts Highway Department Standard Specifications for Highways and Bridges (MHDSSHB), latest edition, and all applicable rules and regulations of the Town of Yarmouth.

PART 2 - PRODUCTS

2.01 GRAVEL SUBBASE AND BASE

- A. Gravel Base and Subbase shall consist of inert material that is hard, durable stone and coarse sand, free from loam and clay, surface coatings and deleterious materials.
- B. Gradation requirements for the Base and Subbase shall be determined by AASHTO-T11 and T27 and shall conform to the following;

Sieve Designation	Percent Passing
½ in.	50-85
No. 4	40-75
No. 50	8-28
No. 200	0-10

- C. Maximum size of stone in gravel shall be as follows:

M1.03.1, Processed Gravel

PART 3 - EXECUTION

3.01 SUBGRADE PREPARATION

- A. All subsurface utility construction shall be completed before fine grading is begun.
- B. The pavement and curb subgrade shall be fine graded to the location, elevations and cross slope shown on the Drawings.
- C. Subgrades in in-situ soils in excavation areas and in embankment areas shall be compacted during fine grading to 95% of maximum dry density.

3.02 BASE MATERIAL PLACEMENT

- A. Base material shall not be placed until the Engineer has approved the fine grading, compaction and condition of the subgrade.

- B. Base material shall be spread on the approved subbase in layers not exceeding four inches in thickness by approved self-spreading equipment. Any displacement of the subbase material by equipment shall be restored to the required grade and recompact before of the base material.
- C. Prior to placing fill, the subgrade should be densified with at least 4 passes of a 10-ton vibratory roller (or equivalent) under the observation of a qualified geotechnical engineer, or his/her representative. Any soft or loose zones identified by the compaction effort should be evaluated by excavation and replaced with compacted Granular Fill as necessary.
- D. Fill to be placed in paved areas (below base course) should consist of Granular Fill as specified in Table 2. This material should be placed in loose lifts not exceeding 12 inches thick, and compacted to at least 95 percent of its maximum dry density as determined by ASTM D1557, Method C (Modified Proctor).
- E. The fill material placed directly beneath the asphalt pavement should consist of Pavement Base Course that meets the material specifications in Table 2. The base course should be placed in a single 12-inch thick lift and should be compacted to at least 95 percent of its maximum dry density as determined by ASTM D1557, Method C (Modified Proctor).
- F. Base material shall be compacted to 95% of dry density.
- G. The surface of the base material shall be fine graded to the proposed location, elevations and cross slope shown on the Drawings during final layer compaction operations.

END OF SECTION 32 1110

SECTION 32 1216
BITUMINOUS CONCRETE PAVEMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions, are hereby made a part of this Section.

1.2 SUMMARY

- A. This Section specifies the requirements for bituminous concrete roadway, temporary trench, and driveway pavements.
- B. The work includes:
 - 1. Preparation for bituminous concrete paving.
 - 2. Temporary trench pavements.
 - 3. Sawcutting existing pavements.
 - 4. Pavement markings.
 - 5. Bituminous concrete paving.
 - 6. Stamped bituminous concrete paving.
- C. Related Work: The following Sections contain work related to this Section:
 - 1. Section 31 0130 Earthwork
 - 2. Section 32 1110 Pavement Subbase and Base
 - 3. Section 32 1613 Curbing
 - 4. Section 32 1723 Pavement Markings

1.3 GUARANTEE

- A. All pavement placed shall be maintained by the Contractor for a period of one year. During this period all areas which have settled or are unsatisfactory for traffic shall be refilled and replaced.

1.4 REFERENCE STANDARDS

- A. References herein are made in accordance with the following abbreviations and all work under this Section shall conform to the latest editions as applicable:
 - 1. MS-2: Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types—The Asphalt Institute (AI).
 - 2. MS-3: Asphalt Plant Manual—The Asphalt Institute (AI)
 - 3. Hot Mix Asphalt Paving Handbook—US Army Corps of Engineers, UN-13 (CE MP-ET)
 - 4. MS-19: Basic Asphalt Emulsion Manual—The Asphaltic Institute (AI)
 - 5. ASTM D946—Specification for Penetration - Graded Asphalt Cement for use in Pavement Construction
- B. Except as otherwise specified herein, the current Massachusetts Department of Transportation Standard Specifications for Highways and Bridges (MDTSSHB), including all addenda, shall apply to materials and workmanship required for the work of this Section.
- C. Walkways shall comply with Massachusetts Architectural Access Board Code of Massachusetts Regulations 521CMR and the Federal Americans with Disabilities Act.

1.5 WEATHER LIMITATIONS

- A. Construct paving when atmospheric temperature is above 40°F and when base is dry.
- B. The Engineer may, at the entire responsibility of the Contractor, permit work to continue when overtaken by sudden rain, but only with material which may be in transit from the plant at the time, and then only when the temperature of the mixture is within the temperature limits specified and the existing surface on the roadway is not excessively wet.
- C. The required temperature of the bituminous concrete mixture, within a tolerance of plus or minus 15°F, when delivered at the site, will be governed by the temperature of the base upon which the mix is placed, as follows:

Base Temperature in Degrees F	Required Material Temperature in Degrees F For Course Thickness in Inches			
	1	1-1/2	2	3 and Greater
35-40	-	305	295	280
41-50	310	300	285	275
51-60	300	295	280	270
61-70	290	285	275	265
71-80	285	280	270	265
81-90	275	270	265	260
91 & over	270	265	260	255

- D. Tack coat shall be applied only when the ambient temperature is above 40°F, and when the temperature has been above 35°F for 12 hours immediately prior to application. Do not apply when base is wet, contains excess moisture, or during rain.

1.6 SUBMITTALS

- A. Design Mix: Before any paving is constructed, submit actual design mix to the Engineer for review and approval. Design mix submittal shall follow the format indicated in the Asphalt Institute Manual MS-2, Marshall Stability Method; and shall include the type/name of the mix, gradation analysis, grade of asphalt cement used, Marshall Stability (lbs.), flow, and effective asphalt content (percent).
- B. Material Certificates: Submit materials certificate signed by the material producer and Contractor, to the independent testing laboratory certifying that materials comply with, or exceed, the requirements herein.

1.7 COORDINATION

- A. The contractor shall coordinate paving with all other work, especially underground utility construction, to prevent covering up unfinished or uninspected work and loss of time or labor by improper scheduling. Any repaving required shall be done at no additional cost to the Owner.

1.8 PAVEMENT WITHIN PUBLIC RIGHT-OF-WAY

- A. The construction of all pavements within public rights-of-way shall be in accordance with the rules, regulations and requirements of the Public Agency having control and ownership of such rights-of-way.

1.9 GUARANTEE

- A. All pavement placed shall be maintained by the Contractor for a period of one year. During this period, all areas that have settled or are unsatisfactory for traffic and as directed by the Engineer or Public Agency having control and ownership of the public right-of-way shall be replaced at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Mineral Aggregate:

1. Coarse Aggregate shall be clean, crushed rock free from dirt and other objectionable material and shall have a percentage of wear, as determined by the Los Angeles Abrasion Test (AASHTO-T96), of not more than 30.
2. Fine Aggregate: The fine aggregate shall consist of one of the following:
 - a. 100% Natural sand,
 - b. 100% Stone sand,
 - c. A blend of natural sand and stone sand.

The fine aggregate, as delivered to the mixer, shall meet the following gradation requirement, as specified in MassHighway Standard Specifications M3.11.04:

Sieve	Percent Passing	
	Minimum	Maximum
3/8 inch	95	100
No. 8	70	95
No. 50	20	40
No. 200	2	16

In the fine aggregate sieve analysis (passing No. 8), the amount between two successive sieves (No. 16, 30, 50, and 100) shall not exceed 33 percent of the fine aggregate total.

3. The use of reclaimed asphalt pavement in new bituminous pavement will not be permitted unless prior approval is obtained from the Engineer and Owner.

- B. Asphalt Cement: Comply with AASHTO M-226/ASTM D 3381; Table 2 for grades AC-10, AC-20, or AC-30, AR-8000, viscosity grade, depending on local mean annual air temperature, as follows and as specified in MassHighway Standard Specifications M3.11.03 Table A:

Temperature Condition	Asphalt Grades
Cold, mean annual air temperature < 7 degrees C (45 degrees F)	AC-10 85/100 pen.
Warm, mean annual air temperature between 7 degrees C (45 degrees F) and 24 degrees C (75 degrees F)	AC-20 60/70 pen.
Hot, mean annual air temperature > 24 degrees C (75 degrees F)	AC-30

Final acceptance of the proper grade of AC will be made by the Engineer.

- C. Tack Coat: Emulsified asphalt; AASHTO M-140/ASTM D 997 or AASHTO M 208/ASTM D 2397, SS-1h, CSS-1, or CSS-1h, diluted with one part water to one part emulsified asphalt.
- D. Mineral Filler: Rock or slag dust, Portland cement, or other inert material complying with AASHTO M-17/ASTM D 242.
- E. Asphalt-Aggregate Mixture: the design mix shall have a minimum stability based on a 50-blow Marshall Method, complying with AASHTO T245 (ASTM D 1559), of 1200 lb. with a flow between 8 and 16. The Design Mix shall be provided in aggregate gradation and bitumen content, as follows:

SIEVE ANALYSIS OF MIX
PERCENT BY WEIGHT PASSING

Sieve	Top Course	Dense Top Course	Binder Course	Dense Binder Course	Base Course	Dense Mix
2 inch					100	
1 inch			100	100	55-80	
3/4 inch			80-100	80-100		
5/8 inch	100					
1/2 inch	95-100	100	55-75	65-80	40-65	100
3/8 inch	80-100	90-100				80-100
No. 4	50-76	50-76	28-50	48-65	20-45	55-80
No. 8	37-54	37-54	20-38	37-51	15-33	48-63
No. 16	26-40	26-40				36-49
No. 30	17-29	17-29	8-22	17-30	8-17	24-38
No. 50	10-21	10-21	5-15	10-22	4-12	14-27
No. 100	5-16	5-16				6-18
No. 200	2-7	2-7	0-5	0-6	0-4	4-8
Bitumen	5.5-7.0	5.5-7.0	4.5-5.5	5-6	4-5	7-8

Air Voids 3-5%

Allowable variance of percent bitumen by weight of total mix = 0.4+%.

2.2 BITUMINOUS CONCRETE FOR SIDEWALKS AND PARKING AREA

- A. Bituminous concrete for sidewalks and driveways shall conform to the requirements for Dense Top and Binder Course as specified in paragraph 2.1E. The maximum allowable percentage of wear, as determined by the L.A. Abrasion Test (AASHTO-T96), shall be 35 percent.

2.3 TEMPORARY TRENCH PAVEMENT

- A. Bituminous concrete for trenches shall conform to the requirements for Binder Mix as specified in paragraph 2.1E.

2.4 RECLAIMED BASE COURSE

- A. The materials for Reclaimed Base Course shall comply with the requirements of MDTSSHB Section 403 (Supplemental Specifications, November 30, 1994, or latest).

PART 3 - EXECUTION

3.1 GENERAL

- A. The Contractor shall install all pavements in the location and to the grades shown on the Drawings, or approved by the Engineer. The type and thickness of pavement courses shall be as shown on the Drawings.
- B. All work and equipment shall be as specified in MassHighway Standard Specifications Section 460.
- C. Equipment: Maintain equipment in satisfactory operating condition and correct breakdowns in a manner that will not delay or be detrimental to progress of paving operations.
- D. Materials for pavement shall be mixed, delivered, placed and compacted in accordance with Massachusetts Highway Standard Specifications, Sections M3.11 and 460 and as specified herein.
- E. Whenever the subbase becomes dry enough to cause dust problems, control as directed in Section 31 25 11 – Temporary Dust Control.

- F. When the air temperature falls below 50 degrees Fahrenheit, extra precautions shall be taken in drying the aggregates, controlling the temperatures of the materials and placing and compacting the mixtures.
- G. No mixtures shall be placed when the air temperature is below 40 degrees Fahrenheit, nor when the materials on which the mixtures are to be placed contain frost.
- H. No vehicular traffic or loads shall be permitted on the newly completed pavement until adequate stability has been attained and the material has cooled sufficiently to prevent distortion or loss of fines.

3.2 PREPARATION

- A. Proof roll prepared base material surface to identify areas requiring removal and recompaction, and to provide a uniform degree of compaction over the entire pavement area.
- B. Do not begin paving work until deficient base material areas have been corrected and are ready to receive paving. paving shall not be applied until the Engineer inspects and approves the finished base.
- C. Check all frames, covers, grates, water valve boxes and other miscellaneous castings that are located in the proposed pavement areas to ensure that all have been correctly positioned and set to the proper slope and elevation. All covers and grates shall be set flush with the required finished surface. No depressions or mounds will be permitted in the pavement to accommodate inaccuracies in the setting of castings.
- D. All vertical surfaces of structures and existing concrete surfaces in contact with new bituminous pavement shall be painted with a uniform coating of an approved tack coat material. Extreme care shall be exercised in the application of this material to prevent splattering or staining of surfaces that will be exposed after the paving is completed. Surfaces that are stained as a result of the Contractor's operation shall be repaired or replaced at no additional cost to the Owner.

3.3 APPLICATION

- A. Tack Coat:
 - 1. Apply to contact surfaces of all cement concrete and other surfaces abutting or projecting into pavement.
 - 2. Apply tack coat to existing pavement surfaces to receive bituminous concrete overlay at a rate of 0.05 gallons per square yard of surface.
 - 3. Allow to dry until at proper condition to receive paving.

3.4 ASPHALTIC CONCRETE PAVEMENT

- A. Spread bituminous concrete on completed compacted base surface.
- B. Whenever possible, all pavement shall be spread by a self-propelled finishing machine. At inaccessible or irregular areas, pavement may be placed by hand methods. If hand methods are used, the hot mixture shall be spread uniformly to the required depth with hot shovels and rakes. After spreading, the hot mixture shall be carefully smoothed to remove all segregated coarse aggregate and rake marks. Rakes and lutes used for hand spreading shall be of the type designed for this use. Material loads shall not be dumped faster that they can be properly spread. Workers shall not stand on the loose mixture while spreading.
- C. Paving Machine Placement: In larger areas, the binder course shall be placed in a transverse direction to the top course. The top course shall be placed in the direction of surface-water flow. Place in typical strips not less than 10 feet wide.
- D. Joints: Make joints between old and new pavements, and between successive days' work, to ensure continuous bond between adjoining work. Construction joints shall have same

texture, density, and smoothness as other sections of paving. Clean contact surfaces and apply tack coat.

3.5 ROLLING AND COMPACTION

- A. Prior to placing fill, the subgrade should be densified with at least 4 passes of a 10-ton vibratory roller (or equivalent) under the observation of a qualified geotechnical engineer, or his/her representative. Any soft or loose zones identified by the compaction effort should be evaluated by excavation and replaced with compacted Granular Fill as necessary.
- B. Fill to be placed in paved areas (below base course) should consist of Granular Fill as specified in Table 2. This material should be placed in loose lifts not exceeding 12 inches thick, and compacted to at least 95 percent of its maximum dry density as determined by ASTM D1557, Method C (Modified Proctor).
- C. The fill material placed directly beneath the asphalt pavement should consist of Pavement Base Course that meets the material specifications in Table 2. The base course should be placed in a single 12-inch thick lift and should be compacted to at least 95 percent of its maximum dry density as determined by ASTM D1557, Method C (Modified Proctor).
- D. Compact mixture with hot hand tampers or hand rollers in areas inaccessible by self-propelled rollers.
- E. Accomplish breakdown or initial rolling immediately following rolling of joints and outside edge. Check surface after breakdown rolling, and repair displaced areas by loosening and filling, if required, with hot material.
- F. Follow breakdown rolling as soon as possible, while mixture is hot. Continue second rolling until mixture has been thoroughly compacted.
- G. Perform finish rolling while mixture is still warm enough for removal of roller marks. Continue rolling until roller marks are eliminated and course has attained maximum density.
- H. Remove and replace paving areas mixed with foreign materials and defective areas and fill with fresh, hot top or binder course material. Compact by rolling to maximum surface density and smoothness.
- I. After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened. Erect barricades to protect paving from traffic.

3.6 TEMPORARY TRENCH PAVEMENT

- A. Where specified and as directed by the Engineer, or as required, and after placement of the gravel subbase, temporary bituminous concrete pavement shall be placed above the trench, between the edges of the existing pavement. Temporary trench pavement shall be installed to the dimensions shown on the drawings.
- B. The temporary trench pavement shall be repaired as necessary to maintain the surface of the pavement until completion of the contract. When a depression of one half inches in depth is observed, the Contractor shall apply a leveling course of bituminous concrete.
- C. Final pavement shall not be placed over trenches until the Base Course pavement has been in place over an entire winter season (November 15 to April 15) unless otherwise directed in writing by the Engineer.

3.7 ASPHALT STAMPING

- A. Using flexible templates, stamp the pattern into the asphalt using a vibratory plat compactor.
- B. Stamping shall be performed on freshly placed asphalt surface while asphalt is still pliable.

3.8 FIELD QUALITY CONTROL

- A. Independent Testing Laboratory, selected and paid by Owner, may be retained to perform construction testing of in-place bituminous concrete courses for compliance with requirements for thickness and surface smoothness. Top and base courses will be randomly cored by the testing laboratory technicians at a minimum rate of one core for every 20,000 square feet of paving, however, no less than three cores in light duty areas and three cores in heavy duty areas will be obtained. Core holes shall be immediately filled with bituminous or cement concrete by the Contractor. pavement samples will be tested for conformance with the mix design.
- B. Grade Control: Establish and maintain required lines and elevations.
- C. Thickness: In-place compacted thickness shall not be less than thickness specified on the drawings. Areas of deficient paving thickness shall receive a tack coat and a minimum one-inch (1") compacted thickness overlay; or shall be removed and replaced to the proper thickness, at the discretion of the Engineer, until specified thickness of the course is met or exceeded at no additional cost to the Owner.
- D. Surface Smoothness: Testing shall be performed on the finished surface of each course for smoothness, using a ten foot (10') straightedge applied parallel with, and at right angles to centerline of paved area. The results of these tests shall be made available to the Owner upon request. Surfaces will not be acceptable if they exceed the following tolerances for smoothness:
- Base and binder course surface: 1/4 inch
Top course surface: 3/16 inch
- E. Check surface areas at intervals necessary to eliminate ponding areas. Remove and replace unacceptable paving as directed by Owner.
- F. Compaction: Field density test for in-place materials shall be performed by examination of field cores and shall have a minimum compacted density of 95% of laboratory Marshall Density in accordance with one of the following standards:
1. Bulk Specific Gravity and Density of Compacted Bituminous Mixture Using Paraffin-Coated Specimens: ASTM D-1188.
 2. Bulk Specific Gravity of Compacted Bituminous Mixtures Using Saturated Surface Dry Specimens: ASTM D-2726.
- Areas of insufficient compaction shall be delineated, removed, and replaced in compliance with the specifications at no additional cost to the Owner.

3.9 MEETING EXISTING PAVEMENTS

- A. Where new pavements will abut existing pavements, the Contractor shall sawcut the existing pavements to produce a uniform, smooth joint surface. Sawcutting of existing pavements shall be neat, straight and even lines, and done in a manner that prevents damage to the pavement to remain.
- B. Full-Depth Pavement—Sawcut by approved method to the full depth of the pavement prior to placement of any new pavement. The sawcut surface shall be a neat true line with straight vertical edges free from irregularities. The sawcut surface shall be tack coated immediately prior to the installation of the new abutting bituminous concrete material to provide a bond between the old and new pavement. The new compacted pavement surface shall be finished flush with the abutting pavement.

END OF SECTION 32 1216

**SECTION 32 1413
PRECAST CONCRETE UNIT PAVERS**

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes
 - 1. Preparation of base course.
 - 2. Installation of unit pavers.
- B. Contractor shall coordinate work between all Subcontractors, sections, and trades required for the proper completion of the work.
- C. Contractor is responsible for all health and safety.

1.02 REFERENCES

- A. Reference herein to any technical society, organization, group or regulation are made in accordance with the following abbreviations and, unless otherwise noted or specified, all work under this Section shall conform to the latest edition as applicable.
- B. United States Code of Federal Regulations (CFR)
 - 1. 29 CFR 1926, Safety and Health Regulations for Construction.
- C. American Society for Testing and Materials (ASTM).
 - 1. ASTM C33 - Standard Specification for Concrete Aggregates.
 - 2. ASTM C 97 - Test Methods for Absorption and Bulk Specific Gravity of Dimension Stone.
 - 3. ASTM C 119 - Terminology Relating to Dimension Stone.
 - 4. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - 5. ASTM C 170 - Test Method for Compressive Strength of Dimension Stone.
 - 6. ASTM C270 - Standard Specification for Mortar for Unit Masonry.
 - 7. ASTM C615 - Standard Specification for Granite Dimension Stone.
 - 8. ASTM C 880 - Test Method for Flexural Strength of Dimensional Stone.
 - 9. ASTM C 936 - Standard Specifications for Solid Interlocking Concrete Paving Units.
 - 10. ASTM C1272 - Standard Specification for Heavy Vehicular Paving Brick.
- D. National Building Granite Quarries Association, Inc.

1.03 SUBMITTALS

- A. Product Data: Submit specifications and other data for all materials required, including, but not limited to aggregates, cement, mortar coloring additive, latex polymer modifier for mortar setting bed, bonding compound, and certification that unit pavers comply with specified requirements. Include detailed instructions for handling, storage, installation and protection of all items.
- B. Samples
 - 1. Sufficient samples of unit pavers shall be submitted to the Design Professional through Contractor.
 - 2. Each sample set shall include three samples.

3. Sample set shall show anticipated range of color, natural variations of grain structure, inclusions and any other visual characteristics to be expected in the final installation.
4. Approved sample set shall establish the standard by which the work will be judged.

1.04 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workmen who are trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and methods required for proper performance of the work in this Section. Use equipment of adequate size, capacity and quantity to accomplish the work of this Section in a timely manner.

1.05 STORAGE AND HANDLING

- A. Storage
 1. Transportation carrier shall use appropriate methods to ensure materials are properly supported, stacked, and restrained during transport.
 2. Carefully pack, band and load unit pavers for shipment on wood pallets or skids. Pallets and skids shall be stacked in such a manner as to evenly distribute the weight of the paver and to prevent breakage, cracking, and other damage to the paver. Protect pavers during storage and construction against moisture, soiling, staining and physical damage. No material, which may cause staining, or discoloration may be used for blocking, packing or dunnage. Use polyethylene or other suitable plastic to separate dissimilar materials.
 3. Deliver packaged materials to the Project Site in their original, unopened package or container-bearing label clearly identifying manufacturer's name, brand name, material, weight or volume, and other pertinent information. Packaged materials shall be stored in their original, unbroken package or container in a weather tight and dry place until ready for use in the work.
 4. Deliver unpackaged aggregates in bulk and store to avoid excessive segregation, contamination with other materials or other size aggregates, or freezing.
- B. Handling
 1. Handle unit pavers so as to prevent chipping, breakage, marring, soiling and other damage. Do not use pinch or wrecking bars without protecting edges of stone with wood or other suitable material. Cracked, badly chipped, or stained units will be rejected and shall not be employed in the work.
- C. Protect grout and mortar materials from deterioration due to moisture and/or temperature. Store in a dry location or in waterproof containers. Protect liquid components from freezing.

1.06 JOB CONDITIONS

- A. Existing Conditions: Examine all work that the work of this section is contingent upon and report any deficiencies to Landscape Architect. Commencement of work will be construed to mean complete acceptance of the preparatory work of others.
- B. Cold weather protection:
 1. Frozen Materials: Do not use frozen materials or materials mixed or coated with ice or frost.
 2. Frozen Work: Do not build on frozen subgrade.
 3. Do not use frozen materials or materials mixed or coated with ice or frost. Do not use salt to thaw ice or for any other reason.
 4. During all seasons, protect partially completed work against weather when work is not in progress.

PART 2 - PRODUCTS

2.01 UNIT PAVER BASE

- A. Processed Gravel Base in accordance with Section 31 0130 2.01.

2.02 SAND

- A. Sand in accordance with Section 31 0130 2.01.

2.03 PAVING UNITS - CONCRETE

- A. Concrete Units: ASTM C 936.

2.04 JOINT STABILIZING SAND

- A. Polymeric Sand, properties and gradation conforming to ASTM C-136.
 - 1. Sand and water-activated polymer mixture.
 - 2. Color: Grey.
 - 3. Gradation:

Gradation of Polymeric Sand Joint Stabilizer

Sieve Size	Natural Sand Percent Passing	Manufactured
NO. 4 (4.75 MM)	100	100
NO. 8 (2.36 MM)	95 TO 100	95 TO 100
NO. 16 (1.18 MM)	70 TO 100	70 TO 100
NO. 30 (600 MM)	40 TO 75	40 TO 75
NO. 50 (0.300 MM)	10 TO 35	20 TO 40
NO. 100 (0.150 MM)	2 TO 15	10 TO 25
NO. 200 (0.075 MM)	0 TO 10	0 TO 10

PART 3 - EXECUTION

3.01 GENERAL

- A. Do not use paver units with excessive chips, cracks, voids, discoloration or other defects, which might be visible or cause staining in finished work.
 - 1. Cut paver units with motor-driven saw equipment to provide clean, sharp, unchipped edges. Cut units to provide pattern shown and to fit adjoining work neatly. Use full units without cutting wherever possible.
 - 2. Set paver units in patterns shown on drawings and with uniform joints of widths indicated herein.
 - 3. Surface Tolerances: Maintain the surface plane for finished paving not exceeding a tolerance of +/- 1/4" in 10-feet when tested with a 10-foot straight edge.

3.02 PREPARATION OF SUBBASE/BASE

- A. All soft and yielding material, and other portions of the subbase which will not compact readily when rolled, vibrated or tamped, shall be removed and replaced with suitable material. Compact subbase to 95% maximum dry density at optimum moisture content, ASTM D 1557 Method C. Density indicated is minimum required.
 - 1. Protect subgrade from damage. At all times, the subgrade surface shall be kept in such condition that it will drain readily and correctly.
- B. If additional material is required to bring subgrade to specified elevations, utilize Common Fill/Ordinary Borrow as Specified in Section 31 0130 – Earthwork. If additional material is

added above subgrade, compact additional material to 95% maximum dry density at optimum moisture content. Density indicated is minimum required.

3.03 UNIT PAVER BASE

- A. After compaction of subbase, install Unit Paver Base in the thickness indicated on the drawings.
- B. Compact Unit Paver Base to 95% maximum dry density at optimum moisture content, ASTM D 1557 Method C. Density indicated is minimum required.
- C. Finish grade of Unit Paver Base shall be within one-half (1/2) inch of required elevation for setting pavers.
- D. Protect Unit Paver Base from damage. If base becomes rutted or displaced, re-grade as required.

3.04 SAND SETTING BED

- A. Utilize sand setting bed to fine grade to achieve required elevation for setting pavers.

3.05 INSTALLATION

- A. Thoroughly clean all paving units of dirt debris or other contaminants.
- B. Install paving units carefully by hand as shown on the Drawings.
 - 1. Before setting, paver shall be clean and free of dirt and foreign matter on all sides.
 - 2. Each piece shall be carefully bedded in base and tapped home with a rawhide or hardened rubber mallet to a full and solid bearing. Particular care shall be exercised to equalize joint openings.
 - 3. Pavers shall be set true to the required lines and grades.
 - 4. Protect newly laid paving units with panels of plywood or similar material.
 - 5. Do not allow workers on the installed pavers.
 - 6. Advance protective panels as work progresses, but maintain protection in areas subject to continued movement of materials and equipment to avoid creating depressions or disrupting the alignment of paving units.
- C. Joint Treatment: Place paving units with hand tight joints.
 - 1. Fill joints with joint stabilizing sand per manufacturer's instructions.
 - 2. Brush joint stabilizing sand to completely fill joints, and ensure no materials remains on paver surface.
 - 3. Following application of dry product, fog water per manufacturer's instructions.

3.06 PROTECTION

- A. Contractor shall protect all of the work of this section and keep it in first class condition until the completion of the contract. Exercise particular care to prevent damage to the surface of the pavers.
- B. Remove and replace paver units, which are broken, chipped, stained or otherwise damaged. Where directed, remove and replace units, which do not match adjoining paver units. Provide new matching units, install as specified and point-up joints to eliminate evidence of replacement.

END OF SECTION 32 1413

SECTION 32 1613
CURBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions, are hereby made a part of this Section.

1.2 SUMMARY

- A. This Section specifies requirements for curbing and bituminous concrete berms.
- B. The work includes:
 - 1. Furnishing and installing vertical, sloped and transition curbing.
 - 2. Furnishing and installing cast-in-place concrete curbing.
 - 3. Furnishing and installing granite curbing (Alternate)
 - 4. All associated items and operations required to complete the installations, including surface preparation, pavement support, jointing and finishing.
- C. Related Work: The following Sections contain work related to this Section:
 - 1. Section 03 3010 Site Cast-In-Place Concrete
 - 2. Section 31 0130 Earthwork
 - 3. Section 32 1110 Pavement Subbase and Base
 - 4. Section 32 1216 Bituminous Concrete Pavement

1.3 REFERENCE STANDARDS

- A. References herein are made in accordance with the following abbreviations and, all work under this Section shall conform to the latest editions as applicable.
- B. ANSI/ASTM D1751—Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).
- C. Except as otherwise specified herein, the current Massachusetts Department of Transportation Standard Specifications for Highways and Bridges (MDTSSHB), including all addenda, shall apply to materials and workmanship required for the work of this Section.

1.4 SUBMITTALS

- A. Submit Shop Drawings and Manufacturer's literature for curb, indicating size, shape and dimensions, finish and setting method for Engineer's approval.
- B. Precast Curbing: Submit representative test specimens of the cured concrete used in precast units showing a compressive strength of 4,000 pounds prior to shipping any units.
- C. Submit testing data for concrete as required by Section 03 3010 Site Cast-in-Place Concrete.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Curbing shall be protected against staining, chipping, and other damage. Cracked, badly chipped, or stained units will be rejected and shall not be employed in the Work.

PART 2 - PRODUCTS

2.1 HOT MIX ASPHALT CURBING AND CAPE COD BERM

- A. Bituminous concrete for curbing shall be as specified in Section 32 1216 Bituminous Concrete Pavement.
- B. Dimensions shall be as indicated on the Plans.

2.2 CAST-IN-PLACE CONCRETE CURBING

- A. Concrete and reinforcement for cast-in-place concrete curbs shall be as specified in Section 03 3010 Site-Cast-in-Place Concrete.

2.3 GRANITE CURBING (ALTERNATE)

- A. Granite curb shall be basically light gray in color, free from seams and other structural imperfections or flaws which would impair its structural integrity, and of a smooth splitting appearance. Natural color variation characteristic of the deposit from which the curb is obtained will be permitted.
- B. Granite curb shall meet the requirements for Granite Curb Type VA4 per MDTSSHB M9.04.01.
- C. Whenever curbing is sawed, all surfaces that are to be exposed shall be thoroughly cleaned and any iron rust or iron particles removed by sand blasting or other methods approved by the Engineer and any saw mark in excess of 1/8 inch shall be removed.
- D. Dimensions:

- 1. The stones for granite curb shall be cut to the following dimensions:

<u>Min.</u>	<u>Width</u>		<u>Minimum Width</u>
<u>Length</u>	<u>at Top</u>	<u>Depth</u>	<u>at Bottom</u>
6 Feet	6 Inches	17 to 19 Inches	4 Inches (for 2/3 length)

Stones to be set on a radius of 100 feet or less shall be cut to the required curvature, unless otherwise approved and, except for making closures, shall be of the following minimum lengths:

<u>Radius</u>	<u>Minimum Length</u>
50 Feet to 100 Feet	6 Feet
25 Feet to less than 50 Feet	4 Feet 6 Inches

- E. Finish:

- 1. Granite curb shall have a top surface free from wind, shall be peen hammered or sawed to an approximately true plane, and shall have no projections or depressions greater than 1/8 inch. The front and back arris lines shall be pitched straight and true and there shall be no projection on the back surface for 3 inches down from the top which would exceed a batter of 4 inches to 1 foot.
- 2. The front face shall be at right angles to the planes of the top and ends and shall be smooth quarry split, free from drill holes and with no projection of more than 1 inch and no depression of more than 1/2 inch measured from the vertical plane of the face through the arris or pitch line for a distance down from the top of 8 inches. For the remaining distance, there shall be no projection or depression greater than 1 inch measured in the same manner.

3. The ends of all stones shall be square with the planes of the top and face so that when the stones are placed end to end as closely as possible, no space shall show in the joint at the top and face of more than 1/2 inch for the full width of the top and for 8 inches down on the face; after which the end may break back not over 8 inches from the plane of the joint. The arris formed by the intersection of the plane of the joint with the planes of the top and exposed faces shall have no variation from the plane of the top and exposed faces greater than 1/8 inch.

2.4 CEMENT MORTAR

- A. Cement mortar shall be composed of one part Portland Cement and two parts of sand by volume with sufficient water to form a workable mix. Cement shall be Portland Cement Type II.

2.5 TRANSITION SECTIONS

- A. Horizontal transition sections shall be provided at all locations where curb sections change (i.e., vertical to sloped). Vertical transition sections shall also be provided for precast curb sections at wheelchair ramps. Vertical transition sections for granite curb shall be made as shown on the Drawings.

PART 3 - EXECUTION

3.1 GENERAL CURB INSTALLATION

- A. Before curbing is to be placed on pavement, the pavement surface shall be thoroughly swept and cleaned by mechanical sweepers and allowed to dry. If the curb is to be placed on cement concrete pavement, the concrete shall receive a coating of tack coat material prior to placement of the curb.
- B. Bituminous curbing shall be constructed by the use of an approved self-propelled extruding curb machine equipped with a material hopper, distributing screw and curb forming device capable of placing the bituminous mixture to the required lines, grades and proper curb cross-section. Prior to the placement of any curb, Contractor shall submit a detail of the cross-section of the curb mold that he proposes to use to Engineer for approval.

3.2 HOT MIX ASPHALT CURBING AND CAPE COD BERM PLACING AND COMPACTION

- A. The hot bituminous mixture shall be placed in the hopper of the curb paver without segregation and extruded through the mold form to provide the proper compaction and surface texture.
- B. The curb paver shall be properly supported and weighted during operation along the edge of the pavement and shall be guided along string or chalk lines to maintain the proper alignment and level of the completed curb.
- C. Any portions of the completed curb, which are not satisfactorily compacted, show signs of sagging, cracking, and distortion, do not conform to the required lines, grades or cross section, and which cannot be satisfactorily repaired, shall be removed and replaced at no additional cost to the Owner.
- D. Joints: Bituminous curb construction shall be a continuous operation in one direction only without joints. When placing of the curb is discontinued for a length of time that permits the mixture to cool, the curb shall be cut in a true vertical plane and the exposed end painted with tack coat material just prior to placing the fresh curb mixture against the previously constructed curb to achieve a continuous bond.

- E. Curing: The newly completed curb shall be protected from traffic or other disturbance by barricades or other suitable methods until adequate stability has been obtained, but in no case less than twelve hours.

3.3 CAST-IN-PLACE CONCRETE CURBING

- A. General Requirements: Concrete curb shall be constructed of concrete and shall be cast-in-place on the prepared subbase in accordance with the dimensions and details line and grade shown on the Drawings. Curbing shall be constructed using conventional forms and in segments separated by construction joints and expansion joints as specified herein. This item shall consist of concrete curbing constructed or as ordered and in conformity with these specifications.
- B. Forms: Forms shall be metal or acceptable planed and matched lumber, straight and free from warp or other irregularities that will adversely affect the installation. Forms shall conform to the curb cross-section shown on the Drawings and shall be carefully set to line and grade and thoroughly braced and secured in place so that there will be no displacement during placement of the concrete. All forms shall be thoroughly cleaned prior to reuse.
- C. Placing of Concrete: Prior to placement of the concrete, the subgrade shall be moistened and the contact surfaces of the forms shall be given a light coating of oil that will not discolor the concrete. Concrete shall then be placed in the form as near to its final position as practicable, struck off with a template, spaded to prevent “rock-pockets” or “honey combing” adjacent to the forms and finished to a smooth even surface. The concrete may be compacted by mechanical vibrators if approved by Engineer. Placing by slip form methods shall be approved by Engineer.
- D. Expansion Joints: Vertical expansion joints shall be located approximately every seventy-five (75) feet and shall be so arranged that they shall match expansion joints in any adjacent concrete pavements and sidewalks. Unless directed otherwise, expansion joints shall also be installed at the PC and PT of all radius curb. Expansion joints shall be constructed vertical, plumb, and at right angles to the face of the curb.
 - 1. Prior to concreting, all exposed surfaces of the wood filler shall be given a light brush coating of form oil.
 - 2. They shall be one-half ($\frac{1}{2}$) inch in width and formed with premolded bituminous joint filler cut to conform to the cross-section of the curb/curb gutter.
- E. Construction Joints: Vertical construction joints shall be located approximately every fifteen (15) feet being equally spaced between expansion joints. The length of these curb/curb gutter segments may be varied slightly for closures but in no case shall they be less than eight (8) feet. Construction joints shall be vertical, plumb and at right angles to the face of the curb and shall be formed by approved method that will provide complete separation of the curb segments during the placing of the concrete. If curb is formed by slip form methods, the joints shall be sawed as soon as practicable after the concrete has set to preclude raveling during the sawing and before any shrinkage cracking occurs in the concrete.
- F. Finishing: Forms shall be left in place for twenty-four (24) hours or until the concrete has sufficiently hardened as determined by Engineer so that they can be removed without injury to the curb. Upon removal of the forms, the exposed faces of the curb/curb gutter shall be immediately rubbed to a uniform surface. Rubbing shall be performed by experienced and competent concrete finishers. No plastering will be permitted.

3.4 GRANITE CURBING (ALTERNATE)

- A. Excavation:
 - 1. The trench for curb shall be excavated to a width of 18 inches. The concrete base shall be placed in the excavated area, compacted, and graded to the proposed curb subgrade. The curb shall be placed in concrete as shown on the Drawings.
 - 2. The subgrade of the trench shall be a depth below the proposed finished grade of the curb equal to 6 inches plus the depth of the curbstone.
- B. The foundation for the curb shall consist of concrete spread upon the subgrade and after being thoroughly compacted by tamping shall be 6 inches in depth.
- C. The curbing shall be set on edge and settled into place with a heavy wooden hand-rammer, to the line and grade required, straight and true for the full depth.
 - 1. The joints of curb and edging shall be filled with mortar for the full depth and width of the curb, and neatly pointed on the top and front exposed portions. After pointing, the curb and edging shall be cleaned of all excess mortar.
 - 2. The ends of the stone curb at driveways and intersections shall be cut at a bevel or rounded, as shown on the Drawings.
 - 3. Wheelchair ramps shall be constructed with transition sections, as shown on the Drawings.
- D. Immediately after curb is set and jointed, the trench shall be backfilled with concrete and approved material and compacted. The first layer to be 4 inches in depth, thoroughly rammed; the other layers to be not more than 6 inches in depth and thoroughly rammed until the trench is filled.
- E. Procedures for removal and resetting of existing granite curb, and new granite curb, in existing pavements shall include the following:
 - 1. Prior to excavation for existing granite curb removal, the pavement surface shall be cut a minimum of one foot from the face of curb with appropriate pavement cutting equipment.
 - 2. Existing curb shall be carefully excavated, and removed in a manner that protects the curb and existing pavement to remain from damage.
 - 3. Existing granite curb shall be cleaned by sandblasting as required to remove of bituminous material, paint and concrete from exposed surfaces prior to resetting in the proposed work.
 - 4. New granite curb shall be set to match the top of existing granite curb remaining in place at abutting sections and, if required, transitioned to the typical section shown on Drawings within the first section of curb.

END OF SECTION 32 16 13

SECTION 32 1723
PAVEMENT MARKINGS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. The extent of pavement marking is shown on the Drawings.
- B. Work includes, but is not limited to the following.
 - 1. Parking stall divider lines.
 - 2. Wheelchair legends.
 - 3. Diagonal striping.
 - 4. Curb painting.
 - 5. Crosswalks.

1.02 RELATED DOCUMENTS

- A. The General and Supplementary Conditions and General Requirements (Division 1) apply to work specified in this Section.
- B. Commonwealth of Massachusetts Department of Highway Specifications for Highways and Bridges, current edition.
- C. Related Work: The following Sections contain work related to this Section:
 - 1. Section 32 1216 Bituminous Concrete Pavement

1.03 QUALITY ASSURANCE

- A. Provide pavement marking complete in every respect.
- B. Reference Standards: Comply with the current edition of applicable provisions of published codes and standards unless noted otherwise.
 - 1. ASTM D 93, D 562, D 711, D 821, D 1210, D 1475, D 1640, D 2243, D 2369, D 2486, D 3723, D 3960, E 70, and G 53.
 - 2. DOT Code of Federal Regulations, Hazardous Materials and Regulations Board, Reference 49CFR, ICC Regulations.
 - 3. State Standard Specification for Road Construction, latest edition.

1.04 SUBMITTALS TO CIVIL ENGINEER

- A. Shop Drawings: Indicate sizes, shapes, patterns, and colors of marking, and manufacturers and types of paints.

1.05 DELIVERY, STORAGE AND HOLDING

- A. Deliver all materials to the job site with all labels intact and legible at time of installation.
- B. Store materials off ground under cover. Protect from damage or deterioration.

1.06 GUARANTEE

- A. Contractor shall guarantee entire installation for one (1) year from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PAINT

- A. Provide ready-mixed one component waterborne traffic line paint. Materials shall be Fast Dry Acrylic Latex Supreme Traffic Zone Marking Paint from RAE Paint or equal.
- B. Colors
 - 1. White: 1 Gallon 9510-01 & 5 Gallon 9510-05

- 2. Blue: 1 Gallon 4834-01 & 5 Gallon 4834-05
- 3. Yellow: 1 Gallon 9511-01 & 5 Gallon 9511-05
- C. Paints shall contain all necessary co-solvents, dispersants, wetting agents, preservatives and all other additives, so that paint shall retain viscosity. Halogenated solvents and glass beads shall not be permitted.
- D. Volatile Organic Compound (VOC) content shall not exceed 250 grams maximum per liter of paint as determined in accordance with ASTM D 3960 test, excluding water and exempt solvents.

PART 3 - EXECUTION

3.01 INSPECTION

- A. Installer shall examine the substrates and conditions under which materials are to be installed, and notify the Engineer in writing of conditions detrimental to the completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.
- B. Coordinate provisions for installation with work of other trades.
- C. All parking area marking and painting to be protected by appropriate traffic barriers, lighted if necessary, so located as to prohibit parking and traffic until the Engineer gives permission for such.

3.02 CLEANING

- A. All surfaces shall be clean and in a condition to accept markings and paintings.

3.03 PAVEMENT MARKING APPLICATION

- A. The material shall be applied to the pavement by equipment designed and manufactured specifically for the application of pavement markings.
- B. The contractor shall employ the services of a Registered Land Surveyor to provide control for layout of pavement markings.
- C. Paint markings shall be applied at a minimum thickness of 15+ 1 mil. Thermoplastic markings shall be applied at 125 to 188 mils thickness.
- D. Pavement markings shall be applied in accordance with the layout shown on the Drawings. No paint shall be applied to new bituminous pavement until the top course has cured at least one week, and allow two weeks curing for newly installed bituminous concrete curbing.
- E. All parking stalls shall be single stripe and shall be spaced equally. The line indicated on the drawings is on the center line of the stall marking.
- F. Where entire areas are to be cross-hatched, the striping shall conform to the cross-hatching shown on the Drawings.
- G. All parking stall markings shall be straight with sharp corners and clean edges. directional arrows, cross hatching, lane divider stripes, stop lines, and lettering shall be painted white to the size, length, and spacing shown on the Drawings.
- H. All markings shall be applied in one coat with brush, spray, or marking machine over dry clean pavement surfaces, when the atmospheric temperature is at or above 40°F and when the weather is otherwise favorable in the opinion of the Engineer.
- I. Use only skilled workmen who are experienced and normally employed in the work of installing pavement markings. Supply all the necessary equipment and materials required for the work.
- J. The Contractor shall protect the buildings, walks, pavement, curbing, trees, shrubs, mulch and other site fixtures from over-spray of paint and damage from marking operations.

K. Traffic shall not be permitted on the pavement until the paint is thoroughly dry.

3.04 PAINTING

A. The minimum required total Dry Film Thickness (DFT): The DFT shall be the minimum required dry film thickness as measured in mils. or as required by section 2.01 of this specification as well as part of the referenced standard in section 1.02 of the same.

System Coverage Requirements:

1st Coat - 3.0 mils DFT

2nd Coat - 6.0 mils DFT

B. Exterior Paint Systems: Provide the following paint systems as indicated:

1. Parking stall, division and limit lines shall be 4" in width, true and straight. Color: White – DFT 6.0 mils.
2. Wheelchair legends shall be as detailed on Drawing. Color: Blue background with white symbols. Parking stall striping shall be Blue at Handicapped stalls only - DFT 6.0 mils.
3. Diagonal striping Handicapped. Color: White - DFT 6.0 mils.
4. Diagonal striping Fire Lane. Color: Yellow - DFT 6.0 mils.

3.05 COMPLETION

- A. During the progress of the work, the premises shall be kept free of debris and waste resulting from the work in this Section. Upon completion, all surplus material and debris shall be removed from the site.
- B. At completion of work, touch up minor damage to prefinished surfaces to the satisfaction of the Engineer. Replace materials damaged or stained during installation.

END OF SECTION 32 1723

**SECTION 32 9200
SEEDING AND SODDING**

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Preparation of areas to be seeded including removal of existing vegetation.
 - 2. Preparation and placement of lawn soil.
 - 3. Seeding.
 - 4. Hydroseeding.
 - 5. Erosion-control material(s).
- B. Related Sections:
 - 1. Section 31 3010 – Earthwork
 - 2. Section 32 9300 – Planting
- C. Contractor shall coordinate work between all Contractors, sections, and trades required for the proper completion of the work.

1.2 REFERENCES AND STANDARDS

- A. American Society for Testing and Materials (ASTM) Standards, Methods:
 - 1. ASTM C136-01 - Standard Test Method For Sieve Analysis of Fine and Course Aggregates (Dry Sieving).
 - 2. ASTM D422-63 - Standard Test Method For Particle-Size Analysis of Soils (Hydrometer).
 - 3. ASTM D698 - Standard Test Methods For Laboratory Compaction Characteristics of Soil Using Standard Effort (Standard Proctor).
 - 4. ASTM D1556-00 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
 - 5. ASTM D2167-94 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
 - 6. ASTM D2922-01 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
 - 7. ASTM D4972-01 - Standard Test Method For pH of Soils using distilled water.
 - 8. ASTM F1647-02a - Standard Test Method For Organic Matter Content of Putting Green and Sports Turf Zone Mixes.
- B. United States Compost Council
 - 1. Standard Test Methods for the Examination of Compost and Composting (TMECC).
- C. American National Standards Institute (ANSI)
- D. American Society of Agronomy

1.3 DEFINITIONS

- A. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or top surface of a fill or backfill before planting soil is placed.
- B. Planting Soils: Planting Soils are composed of a blend of three base components: base loam, organic material and sand. The quality of the blend depends on the quality of the original components. Contractor is responsible for locating and obtaining approval of sources for base loam, organic material and sand that meet the Specification requirements.

Contractor is then responsible for mixing the components. Approximate mixing ratios are provided, but may require adjustment, depending on the final materials and with the approval of the Landscape Architect or their representative, in order to meet Specification requirements for each blend.

- C. Duff Layer: The surface layer of native topsoil that is composed of mostly decayed leaves, twigs, and detritus.
- D. Finish Grade: Elevation of finished surface of planting soil.
- E. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.
 - 1. All use of pesticides shall conform with the Massachusetts DEP requirements.
- F. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. These include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.
- G. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.
- H. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil, but in disturbed areas such as urban environments, the surface soil can be subsoil.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Pesticides and Herbicides: Include product label and manufacturer's application instructions specific to this Project.
 - 2. Fertilizers
 - 3. Ground Limestone
- B. Grass Seed: From seed vendor for each grass-seed monostand or mixture stating the botanical and common name, percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.
 - 1. Certification of each seed mixture for turfgrass sod. Include identification of source and name and telephone number of supplier.
- C. Qualification Data: For qualified landscape Installer.
- D. Product Certificates: For soil amendments and fertilizers, from manufacturer.
- E. Horticultural Soil Test Reports: Submit reports for each of the planting soil components listed, existing topsoil to remain in place and stripped and stockpiled existing topsoil. Only after approval of initial test reports, submit reports for blended mixes for approval.
 - 1. Testing for base loam, lawn soil, and on-site existing or stripped and stockpiled topsoil.
 - 2. Inform testing agency soil test is for lawn applications.
 - 3. Mechanical and chemical analysis shall be conducted by a public extension service agency or a certified private testing laboratory in accordance with the current "standards" of the American Society of Agronomy.
 - 4. Gradation tests shall be by combined hydrometer and wet sieving in compliance with ASTM D422 after destruction of organic matter by ignition.

5. Test for agricultural suitability analysis including:
 - a. particle size and characteristics
 - b. soil pH by water pH and buffer (smp) pH tests.
 - c. percentage organic content
 - d. nitrate nitrogen
 - e. ammonium nitrogen
 - f. phosphorus
 - g. potassium
 - h. calcium
 - i. aluminum
 - j. magnesium
 - k. manganese
 - l. Micronutrients
 - m. Toxins including but not limited to lead, cadmium, arsenic and mercury.
6. Test results: test data and recommendations for soil amendments including but not limited to: nitrogen, phosphorus, potassium and limestone. State recommendations for soil treatments and soil amendments to be incorporated. State recommendations in weight per 1000 sq. ft. or volume per cu. Yd.
7. Testing for Organic Amendment Materials
 - a. Tests shall be by combined hydrometer and wet sieving in compliance with ASTM D422 after destruction of organic matter by ignition.
 - b. Test for agricultural suitability analysis as defined in Part 2 – Organic Amendment Material (Compost).
- F. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of turf during a calendar year. Submit before expiration of required initial maintenance periods.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified landscape Installer whose work has resulted in successful turf establishment.
 1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.
 2. Experience: Five years' experience in turf installation in addition to requirements in Division 01 Section "Quality Requirements."
 3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
 4. Personnel Certifications: Installer's field supervisor shall have certification in one of the following categories from the Professional Landcare Network:
 - a. Certified Landscape Technician - Exterior, with installation maintenance specialty area(s), designated CLT-Exterior.
 - b. Certified Turfgrass Professional, designated CTP.
 - c. Certified Turfgrass Professional of Cool Season Lawns, designated CTP-CSL.
 5. Pesticide Applicator: State licensed, commercial.

- B. Soil-Testing Laboratory Qualifications: An independent laboratory or university laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.
 - 1. The soil-testing laboratory shall oversee soil sampling, with depth, location, and number of samples to be taken per instructions from Architect. A minimum of three representative samples shall be taken from varied locations for each soil to be used or amended for planting purposes.
- C. Preinstallation Conference: Conduct conference at Project site at least one week prior to turf installation.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Planting Soils shall not be handled, hauled, or placed when wet, during or immediately after a heavy rainfall, or frozen. Soil should be handled only when the moisture content is less than or equal to the optimum water content as determined for the Standard Proctor test.
- B. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws, as applicable.
- C. Bulk Materials:
 - 1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
 - 2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
 - 3. Accompany each delivery of bulk fertilizers, lime, and soil amendments with appropriate certificates.

1.7 PROJECT CONDITIONS

- A. Planting Restrictions: Plant during one of the following periods. Contractor responsible for all maintenance until Substantial Completion.
 - 1. Spring Planting: April 1 - June 15.
 - 2. Fall Planting: August 15 - October 1.
- B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

1.8 MAINTENANCE SERVICE

- A. Initial Turf Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after each area is planted and continue until acceptable turf is established but for not less than the following periods:
 - 1. Seeded Turf: 90 days from date of planting completion.
 - a. When initial maintenance period has not elapsed before end of planting season, or if turf is not fully established, continue maintenance during next planting season.
- B. Initial Conservation Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after each area is planted and continue until acceptable growth is established (determined by Landscape Architect and Construction Manager), but for not less than 90 days from date of planting completion.

PART 2 PRODUCTS

2.1 BASE LOAM

- A. Base Loam shall be imported and shall be free of subsoil, large stones, earth clods, sticks, stumps, clay lumps, roots or other objectionable, extraneous matter or debris. Base Loam shall be from a natural source without admixture of compost, sand or any other extraneous material. Base Loam shall also be free of quack-grass rhizomes, *Agropyron Repens*, and the nut-like tubers of nutgrass, *Cyperus Esculentus*, and all other primary noxious weeds. Base Loam shall not be delivered or mixed while in a frozen or muddy condition.
- B. Base Loam shall consist of fertile, friable, natural loam capable of sustaining vigorous plant growth. Loam shall be without admixture of subsoil, and refuse, resulting in a homogeneous material free of stones greater than ½" in the longest dimension, be free of lumps, plants, glass, roots, sticks, excessive stone content, debris, and extraneous matter as determined by the Landscape Architect.
- C. Base Loam for mixing shall conform to the following grain size distribution for material passing the #10 sieve:

U.S. Sieve Size	Percent Passing Minimum	Percent Passing Maximum
No. 10		100
No. 18	85	100
No. 35	70	95
No. 60	50	85
No. 140	36	63
No. 270	32	42
.002mm	3	8

- D. Maximum size shall be one inch largest dimension. The maximum retained on the #10 sieve shall be 20% by weight of the total sample.
- E. The organic content shall be between 3.0 and 8.0 percent.
- F. The pH shall be 7.5 or less.
- G. It shall be uncontaminated by salt water, foreign matter and substances harmful to plant growth. The maximum soluble salt index shall be 100. Base Loam shall not have levels of aluminum great than 200 parts per million.
- H. If limestone is required to amend the screened loam to bring it within a pH range of 5.5 to 7.5 no more than 200 pounds of limestone per 1,000 square feet of loam, incorporated into the soil, or 50 pounds of limestone per 1,000 square feet of loam, surface application, within a single season.
- I. The Engineer will reject any material delivered to the site that, after post-delivery testing, does not meet these specifications. If the delivered screened loam does not meet the specifications stated in this document the delivered screened loam will be removed by the contractor at the contractors expense and at the time of rejection.
- J. The Contractor shall take representative samples of topsoil from the site and from topsoil to be hauled in and shall submit samples to a Soil Testing Laboratory for chemical analysis, and physical analysis. The Contractor shall indicate to the testing agencies that turf is to be planted and who the Owner is. The Contractor shall forward to the Owner two copies of analysis and recommendations of the testing agencies.

- K. Existing, in-place surface soil. Verify suitability of existing surface soil to produce viable base loam or lawn soil, which has been stockpiled on the site, may be used provided it can be made to comply with these Specifications herein for base loam or lawn soil.

2.2 ORGANIC AMENDMENT MATERIAL (COMPOST)

- A. Organic Material (Compost) for amending planting medium: stable, humus-like material produced from the aerobic decomposition of organic residues consisting of Leaf or Yard Waste Compost which shall have been composted for a minimum of one year (12 months). Compost shall be free of debris such as plastics, metal, concrete or other debris and stones larger than 1/2", larger branches and roots and wood chips over 1/2" in length or diameter. Compost shall be a dark brown to black color and be capable of supporting plant growth with appropriate management applicable, with no visible free water or dust, with no unpleasant odor, and meeting the following criteria as reported by laboratory tests.
 - 1. The ratio of carbon to nitrogen shall be in the range of 12:1 to 25:1.
 - 2. Stability shall be assessed by the Solvita procedure. Protocols are specified by the Solvita manual (version 4.0). The compost must achieve a maturity index of 6 or more as measured by the Solvita scale.
 - 3. Pathogens/Metals/Vector Attraction reduction shall meet all State of Connecticut requirements for applications to soils with human activity.
 - 4. Organic Content: at least 20 percent (dry weight). One hundred percent of the material shall pass a 1/2-inch (or smaller) screen. Debris such as metal, glass, plastic, wood (other than residual chips), asphalt or masonry shall not be visible and shall not exceed one percent dry weight. Organic content shall be determined by weight loss on ignition or H₂O₂ for particles passing a Number 10 sieve.
 - 5. pH: between 6.5 to 7.2.
 - 6. Salinity: Electrical conductivity of a one to five soil to water ratio extract shall not exceed 2.0 mmhos/cm (dS/m).
 - 7. Compost: screened to 1/2 inch maximum particle size and shall contain no more than 3 percent material finer than 0.002mm as determined by hydrometer test on ashed material.
 - 8. Nutrient content: determined Soil Testing Laboratory and utilized to evaluate soil required amendments for the mixed soils. Chemical analysis shall be undertaken for Nitrate Nitrogen, Ammonium Nitrogen, Phosphorus, Potassium, Calcium, Aluminum, Magnesium, Chromium, Iron, Manganese, Lead, Soluble Salts, Cation Exchange Capacity, soil reaction (pH), buffer pH, and micronutrients.

2.3 SAND

- A. Sand as Amendment for Soil Mediums and for Drainage.
 - 1. Sand shall be uniformly graded medium to coarse sand consisting of clean, inert, rounded grains of quartz or other durable rock and free from loam or clay, surface coatings, mica, other deleterious materials with the following gradation. Calcitic sand is not permitted.

U.S. Sieve Size	Percent Passing Minimum	Percent Passing Maximum
No. 10	100	--
No. 18	65	90
No. 35	35	60
No. 60	15	30
No. 140	0	8
No. 270	0	3
.002mm	0	0.5

- B. Maximum size shall be one inch largest dimension. The maximum retained on the #10 sieve shall be 15% by weight of the total sample.
- C. The ratio of the particle size for 70% passing (D70) to the particle size for 20% passing (D20) shall be 3.0 or less. (D70/D20 <3.0)
- D. Saturated hydraulic conductivity of the sand shall be not less than 30 inches per hour, according to ASTM D5856-95 (2000), when compacted to a minimum of 90% Standard Proctor, ASTM 698.
- E. The pH shall be 7.5 or less.

2.4 LAWN SOIL

- A. Base Loam, Sand and Compost, each as specified above, shall be combined in an approximate mix ratio of three parts by volume Sand to two parts by volume Base Loam to one and one half parts by volume Compost (3S:2L:1.5C) to create a uniform blend which meets the following requirements:
 - 1. Gradation for Material Passing the Number 10 Sieve:

U.S. Sieve Size	Percent Passing Minimum	Percent Passing Maximum
No. 10	100	--
No. 18	70	95
No. 35	46	74
No. 60	30	56
No. 140	17	26
No. 270	14	18
.002mm	1	2

- B. Maximum size shall be one inch largest dimension. The maximum retained on the #10 sieve shall be 15% by weight of the total sample.
- C. Ratio of the particle size for 80% passing (D80) to the particle size for 30% passing (D30) shall be 5.0 or less. (D80/D30 <5.0)
- D. Saturated hydraulic conductivity of the mix: not less than 3 inches per hour according to ASTM D5856-95 (2000) when compacted to a minimum of 86% Standard Proctor, ASTM 698.
- E. Organic content: between 4.0 and 5.0 percent by weight.
- F. The pH of the mix shall be between 6.5 and 7.2.

2.5 SEED

- A. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Journal of Seed Technology; Rules for Testing Seeds" for purity and germination tolerances.
- B. Seed Species: State-certified seed of grass species as follows:
- C. Seed Species: Seed of grass species as follows, with not less than 95 percent germination, not less than 85 percent pure seed, and not more than 0.5 percent weed seed:
 - 1. Seed Mix for lawns.

Grass Species	Percent by weight
Turf Type Tall Fescue	40%
Fine Fescue	20%
Kentucky Bluegrass	20%
Perennial Ryegrass	20%

2.6 INORGANIC SOIL AMENDMENTS

- A. Lime: ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:
 - 1. Class: T, with a minimum of 99 percent passing through No. 8 sieve and a minimum of 75 percent passing through No. 60 sieve.
 - 2. Class: O, with a minimum of 95 percent passing through No. 8 sieve and a minimum of 55 percent passing through No. 60 sieve.
 - 3. Provide lime in form of ground dolomitic limestone or calcitic limestone depending on recommendation from soil analysis.
- B. Sulfur: Granular, biodegradable, containing a minimum of 90 percent sulfur, and with a minimum of 99 percent passing through No. 6 sieve and a maximum of 10 percent passing through No. 40 sieve.
- C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.
- D. Aluminum Sulfate: Commercial grade, unadulterated.
- E. Perlite: Horticultural perlite, soil amendment grade.
- F. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through No. 50 sieve.
- G. Sand: Clean, washed, natural or manufactured, and free of toxic materials.
- H. Diatomaceous Earth: Calcined, 90 percent silica, with approximately 140 percent water absorption capacity by weight.
- I. Zeolites: Mineral clinoptilolite with at least 60 percent water absorption by weight.

2.7 ORGANIC SOIL AMENDMENTS

- A. Amendments, fertilizers, and conditioners shall be recommended in the Horticultural Soil Test Reports.
- B. Organic fertilizers are derived from several sources. Bonemeal in first paragraph below is organic and primarily phosphorous, has an alkaline reaction, and is nonburning. Other organic fertilizers include blood meal, cottonseed meal, seaweed meal, soybean meal, alfalfa meal, and blends of these materials.
- C. Bonemeal: Commercial, raw or steamed, finely ground; a minimum of 1 percent nitrogen and 10 percent phosphoric acid.

- D. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.

2.8 MULCHES

- A. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.
- B. Compost Mulch: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1-inch sieve; soluble salt content of <2 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:
 - 1. Organic Matter Content: 50 to 60 percent of dry weight.
 - 2. Feedstock: Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.
- C. Fiber Mulch: Biodegradable, dyed-wood, cellulose-fiber mulch; nontoxic and free of plant-growth or germination inhibitors; with a maximum moisture content of 15 percent and a pH range of 4.5 to 6.5.
- D. Nonasphaltic Tackifier: Colloidal tackifier recommended by fiber-mulch manufacturer for slurry application; nontoxic and free of plant-growth or germination inhibitors.

2.9 PESTICIDES

- A. General: Pesticide, registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.
- B. Pre-Emergent Herbicide (Selective and Non-Selective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.
- C. Post-Emergent Herbicide (Selective and Non-Selective): Effective for controlling weed growth that has already germinated.

2.10 WATER

- A. Water: furnished by Contractor, unless otherwise specified, and suitable for irrigation and free from ingredients harmful to plant life. Hose and other watering equipment furnished by Contractor.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine areas to be planted for compliance with requirements and other conditions affecting performance.
 - 1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
 - 2. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.
 - 3. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
 - 4. Uniformly moisten excessively dry soil that is not workable and which is too dusty.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

- C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.

3.2 GENERAL PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities, trees, shrubs, and plantings from damage caused by planting operations.
 - 1. Protect adjacent and adjoining areas from hydroseeding and hydromulching overspray.
 - 2. Protect grade stakes set by others until directed to remove them.
- B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
- C. Unchanged Subgrades: If turf is to be planted in areas unaltered or undisturbed by excavating, grading, or surface-soil stripping operations, prepare surface soil as follows:
 - 1. Remove existing grass, vegetation, and turf in areas called for on the drawings. Do not mix into surface soil.
 - 2. Loosen surface soil to a depth of at least 6 inches. Apply soil amendments and fertilizers according to test reports and mix thoroughly into top 6 inches of soil. Till soil to a homogeneous mixture of fine texture.
 - 3. Apply superphosphate fertilizer directly to surface soil before loosening.
 - 4. Remove stones larger than 1 inch in any dimension and sticks, roots, trash, and other extraneous matter.
 - 5. Legally dispose of waste material, including grass, vegetation, and turf, off Owner's property.

3.3 PREPARATION OF PLANTING SOILS

- A. Correct deficiencies in soil as directed by soil test results. Thoroughly incorporate amendments into planting mixture to ensure even distribution.

3.4 DECOMPACTION OF LAWN AREAS

- A. All subgrade areas to receive planting soils, shall be loosened to a minimum depth of three inches utilizing the bucket of an excavator or approved equivalent equipment.
- B. After the soils have been loosened, Lawn Soils may be spread by using a wide-track bulldozer size D-5 or smaller or may be dumped and spread with the bucket of a backhoe from the edge of the loosened area. No rubber-tired equipment or heavy equipment except for a small bulldozer shall pass over the subsoils (subgrade) after they have been loosened. If Contractor plans to utilize such areas for use of heavy equipment, this work should be carried out prior to beginning the process of loosening soils or filling in that area, or it will have to be re-scarified and meet this specification requirement.

3.5 PLACEMENT OF LAWN SOIL

- A. After approval of subgrade, place and spread lawn soil in lifts not greater than twelve inches and compact with a minimum of three passes of the tracks of a bulldozer to a density between 83 and 86 percent Standard Proctor Maximum Dry Density.
- B. Place and spread planting medium to a depth greater than required such that after settlement, finished grade conforming to the lines, grades and elevations shown on the Drawings. Ensure proper drainage in an uninterrupted pattern free of hollows and pockets.
- C. Remove stiff clods, lumps, brush, roots, stumps, litter and other foreign material and stones over one inch in diameter and dispose of legally off site.
- D. Smoothly round-off all top and toe of slopes. Reinstall erosion control devices and protective fencing as required.

- E. Determine the bulk density of the topsoil prior to approval of finish grade, using an approximate method outlined in C.A. Black (ed) Methods of Soil Analysis, Part 1, American Society of Agronomy, 1965. Final bulk density of the topsoil shall have a mean value of approximately 1.35 g cm⁻³ (85 lbs. per cu. ft.) taken from 5 samples from each field with no value exceeding 1.40 g cm⁻³ (88 lbs. per cu. ft.).

3.6 FIELD QUALITY CONTROL

- A. Confirm that the subgrade is at the proper elevation and that no further earthwork is required to bring the subgrade to proper elevations. Subgrade layer elevations shall slope parallel to the finished grade as shown on the Contract Documents. Provide a written report to the Owner's Representative and the Owner's Representative that the subgrade has been adjusted to the required elevations to provide a uniform thickness of planting media across the area. Perform no work of placing and spreading soil until elevations have been confirmed and written report has been accepted by the Owner's Representative.
- B. As provided in Part 1.7 – Project Conditions, No Base Materials or Soil Medium and no subgrade materials shall be handled, planted, or seeded in any way if it is in a wet or frozen condition. A moist Soil Medium is desirable for planting.

3.7 TURF AREA PREPARATION

- A. Limit turf subgrade preparation to areas to be planted.
- B. For spring seeding provide sidurn for pre-emergence crabgrass control. Repeat applications as needed and in accordance with the manufacturer's recommendation.
- C. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.
- D. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.8 PROTECTION

- A. Protect work of this section until Final Acceptance.
- B. Select equipment and otherwise phase the installation of the Soil Medium to ensure that wheeled equipment does not travel over prepared subsoil, placed fills or already installed soil. Movement of tracked equipment over said soils will be reviewed and considered for approval by the Owner's Representative. If it is determined by the Owner's Representative that wheeled equipment must travel over already installed soil, provide a written description of sequencing of work that ensures that compacted soil is loosened and un-compacted as the work progresses or place one-inch thick steel plate ballast (or equivalent ballast approved by the Owner's Representative) over the length and width of any travel way to cover Soil Medium to protect it from compaction.
- C. Disturbed areas outside the limit of work shall be protected as required, graded smooth and spread with Soil Medium to meet finished grades.
- D. For erosion-control mats, install planting soil in two lifts, with second lift equal to thickness of erosion-control mats. Install erosion-control mat and fasten as recommended by material manufacturer.
- E. Fill cells of erosion-control mat with planting soil and compact before planting.
- F. For erosion-control blanket or mesh, install from top of slope, working downward, and as recommended by material manufacturer for site conditions. Fasten as recommended by material manufacturer.

3.9 LAWN SEEDING

- A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.
 - 1. Do not use wet seed or seed that is moldy or otherwise damaged.
 - 2. Do not seed against existing trees. Limit extent of seed to outside edge of planting saucer.
- B. Sow seed at a total rate of 3 to 4 lb/1000 sq. ft..
- C. Rake seed lightly into top 1/8 inch of soil, roll lightly, and water with fine spray.
- D. Protect seeded areas with slopes exceeding 1:4 with erosion-control blankets and 1:6 with erosion-control fiber mesh installed and stapled according to manufacturer's written instructions.
- E. Protect seeded areas with erosion-control mats where shown on Drawings; install and anchor according to manufacturer's written instructions.
- F. Protect seeded areas with slopes not exceeding 1:6 by spreading straw mulch. Spread uniformly at a minimum rate of 2 tons/acre to form a continuous blanket in loose thickness over seeded areas. Spread by hand, blower, or other suitable equipment.
 - 1. Anchor straw mulch by crimping into soil with suitable mechanical equipment.
 - 2. Bond straw mulch by spraying with asphalt emulsion at a rate of 10 to 13 gal./1000 sq. ft.. Take precautions to prevent damage or staining of structures or other plantings adjacent to mulched areas. Immediately clean damaged or stained areas.
- G. Protect seeded areas from hot, dry weather or drying winds by applying compost mulch within 24 hours after completing seeding operations. Soak areas, scatter mulch uniformly to a thickness of 3/16 inch, and roll surface smooth.

3.10 HYDROSEEDING

- A. Hydroseeding: Mix specified seed, fertilizer, and fiber mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogeneous slurry suitable for hydraulic application.
 - 1. Mix slurry with nonasphaltic tackifier.
 - 2. Apply slurry uniformly to all areas to be seeded in a one-step process. Apply slurry at a rate so that mulch component is deposited at not less than 1500-lb/acre dry weight, and seed component is deposited at not less than the specified seed-sowing rate.
 - 3. Apply slurry uniformly to all areas to be seeded in a two-step process. Apply first slurry coat at a rate so that mulch component is deposited at not less than 500-lb/acre dry weight, and seed component is deposited at not less than the specified seed-sowing rate. Apply slurry cover coat of fiber mulch (hydromulching) at a rate of 1000 lb/acre.

3.11 TURF RENOVATION

- A. Renovate existing turf damaged by Contractor's operations, such as storage of materials or equipment and movement of vehicles.
 - 1. Reestablish turf where settlement or washouts occur or where minor regrading is required.
 - 2. Install new planting soil as required.
- B. Remove sod and vegetation from diseased or unsatisfactory turf areas; do not bury in soil.
- C. Remove topsoil containing foreign materials such as oil drippings, fuel spills, stones, gravel, and other construction materials resulting from Contractor's operations, and replace with new planting soil.

- D. Mow, dethatch, core aerate, and rake existing turf.
- E. Remove weeds before seeding. Where weeds are extensive, apply selective herbicides as required. Do not use pre-emergence herbicides.
- F. Remove waste and foreign materials, including weeds, soil cores, grass, vegetation, and turf, and legally dispose of them off Owner's property.
- G. Till stripped, bare, and compacted areas thoroughly to a soil depth of 6 inches.
- H. Apply soil amendments and initial fertilizers required for establishing new turf and mix thoroughly into top 4 inches of existing soil. Install new planting soil to fill low spots and meet finish grades.
- I. Apply seed and protect with straw mulch as required for new turf.
- J. Water newly planted areas and keep moist until new turf is established.

3.12 TURF MAINTENANCE

- A. Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.
 - 1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.
 - 2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
 - 3. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.
- B. Watering: Install and maintain temporary piping, hoses, and turf-watering equipment to convey water from sources and to keep turf uniformly moist to a depth of 4 inches. The contractor shall provide all irrigation equipment and water as necessary to irrigate the seeded areas daily with ¼ acre inch of water per day using 3 sets to keep the surface moist and to maintain soil moisture at or near field capacity so that the seedbed does not dry out and adequate rooting takes place. The amount of water per dy and the number of sets may be adjusted at the request of the Owner. The irrigation schedule shall further be adjusted after the seedling plants and sod are rooted. The quantity of water used per day shall be recorded and reported daily to the Construction Manager for the first three week from seeding and weekly thereafter.
- C. Mow turf at 5 day intervals commencing as soon as the seedlings in the seeded areas reach 2 inches in height. Repeat mowing to maintain specified height without cutting more than 1/3 of grass height. Remove no more than 1/3 of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain the following grass height:
 - 1. Mow lawn areas to a height of 2.5 to 3 inches.
- D. Turf Post Fertilization: Apply fertilizer after initial mowing and when grass is dry.
 - 1. Use fertilizer that will provide actual nitrogen of at least 1 lb/1000 sq. ft. to turf area.

3.13 SATISFACTORY TURF

- A. Turf installations shall meet the following criteria as determined by Architect:
 - 1. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds, stones, debris, and surface

irregularities, with coverage exceeding 90 percent over any 10 sq. ft. and bare spots not exceeding 2 by 2 inches.

- B. Use specified materials to reestablish turf that does not comply with requirements and continue maintenance until turf is satisfactory.

3.14 PESTICIDE APPLICATION

- A. Apply pesticides and other chemical products and biological control agents in accordance with requirements of authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.
- B. Post-Emergent Herbicides (Selective and Non-Selective): Apply only as necessary to treat already-germinated weeds and in accordance with manufacturer's written recommendations.

3.15 CLEANUP AND PROTECTION

- A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas. On a daily basis.
- B. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.
- C. Remove nondegradable erosion-control measures after grass establishment period.

END OF SECTION 32 9200

SECTION 32 9300
PLANTING

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. Includes:
1. Preparation and placement of planting soil.
 2. Plants.
 3. Tree stabilization.

1.1 REFERENCES AND STANDARDS

- A. American Society for Testing and Materials (ASTM) Standards, Methods:
1. ASTM C136-01 - Standard Test Method for Sieve Analysis of Fine and Course Aggregates (Dry Sieving).
 2. ASTM D422-63 - Standard Test Method for Particle-Size Analysis of Soils (Hy-drometer).
 3. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (Standard Proctor).
 4. ASTM D1556-00 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
 5. ASTM D2167-94 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
 6. ASTM D2922-01 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
 7. ASTM D4972-01 - Standard Test Method for pH of Soils using distilled water.
 8. ASTM F1647-02a - Standard Test Method for Organic Matter Content of Putting Green and Sports Turf Zone Mixes.
- B. United States Compost Council
1. Standard Test Methods for the Examination of Compost and Composting (TMECC).
- C. American National Standards Institute (ANSI)
1. ANSI Z60.1, American Standards for Nursery Stock, latest edition.
- D. American Society of Agronomy

1.2 DEFINITIONS

- A. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or top surface of a fill or backfill before planting soil is placed.
- B. Planting Soils: Planting Soils are composed of a blend of three base components: base loam, organic material and sand. The quality of the blend depends on the quality of the original components. Contractor is responsible for locating and obtaining approval of sources for base loam, organic material and sand that meet the Specification requirements. Contractor is then responsible for mixing the components. Approximate mixing ratios are provided, but may require adjustment, depending on the final materials and with the approval of the Landscape Architect or their representative, in order to meet Specification requirements for each blend.
- C. Backfill: The earth used to replace or the act of replacing earth in an excavation.

- D. Balled and Burlapped Stock: Plants dug with firm, natural balls of earth in which they were grown, with ball size not less than sizes indicated; wrapped with burlap, tied, rigidly supported, and drum laced with twine with the root flare visible at the surface of the ball as recommended by ANSI Z60.1.
- E. Balled and Potted Stock: Plants dug with firm, natural balls of earth in which they are grown and placed, unbroken, in a container. Ball size is not less than sizes indicated.
- F. Bare-Root Stock: Plants with a well-branched, fibrous-root system developed by transplanting or root pruning, with soil or growing medium removed, and with not less than minimum root spread according to ANSI Z60.1 for type and size of plant required.
- G. Container-Grown Stock: Healthy, vigorous, well-rooted plants grown in a container, with a well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of plant required.
- H. Duff Layer: The surface layer of native topsoil that is composed of mostly decayed leaves, twigs, and detritus.
- I. Fabric Bag-Grown Stock: Healthy, vigorous, well-rooted plants established and grown in-ground in a porous fabric bag with well-established root system reaching sides of fabric bag. Fabric bag size is not less than diameter, depth, and volume required by ANSI Z60.1 for type and size of plant.
- J. Finish Grade: Elevation of finished surface of planting soil.
- K. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.
- L. Pests: Living organisms that occur where they are not desired, or that cause damage to plants, animals, or people. These include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.
- M. Planting Area: Areas to be planted.
- N. Plant; Plants; Plant Material: These terms refer to vegetation in general, including trees, shrubs, vines, ground covers, ornamental grasses, bulbs, corms, tubers, or herbaceous vegetation.
- O. Root Flare: Also called "trunk flare." The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.
- P. Stem Girdling Roots: Roots that encircle the stems (trunks) of trees below the soil surface.
- Q. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.
- R. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated, including soils.
 - 1. Plant Materials: Include quantities, sizes, quality, and sources for plant materials.
 - 2. Pesticides and Herbicides: Include product label and manufacturer's application instructions specific to the Project.
 - a. Contractor shall follow all Connecticut DEEP regulations for pesticide and herbicide applications.
 - 3. Fertilizers

4. Ground Limestone
 5. Plant Photographs: Include color photographs in 3- by 5-inch print format of each required species and size of plant material as it will be furnished to the Project. Take photographs from an angle depicting true size and condition of the typical plant to be furnished. Include a scale rod or other measuring device in each photograph. For species where more than 20 plants are required, include a minimum of three photographs showing the average plant, the best quality plant, and the worst quality plant to be furnished. Identify each photograph with the full scientific name of the plant, plant size, and name of the growing nursery.
- B. Horticultural Soil Test Reports: Submit reports for each of the planting soil components listed, existing topsoil to remain in place, stripped and stockpiled existing topsoil. Only after approval of initial test reports, submit reports for blended mixes for approval.
1. Testing for base loam, lawn soil, and on-site existing or stripped and stockpiled topsoil.
 2. Inform testing agency soil test is for lawn applications.
 3. Mechanical and chemical analysis shall be conducted by a public extension service agency or a certified private testing laboratory in accordance with the current “standards” of the American Society of Agronomy.
 4. Gradation tests shall be by combined hydrometer and wet sieving in compliance with ASTM D422 after destruction of organic matter by ignition.
 5. Test for agricultural suitability analysis including:
 - a. particle size and characteristics
 - b. soil pH by water pH and buffer (smp) pH tests.
 - c. percentage organic content
 - d. nitrate nitrogen
 - e. ammonium nitrogen
 - f. phosphorus
 - g. potassium
 - h. calcium
 - i. aluminum
 - j. magnesium
 - k. manganese
 - l. Micronutrients
 - m. Toxins including but not limited to lead, cadmium, arsenic and mercury.
 6. Test results: test data and recommendations for soil amendments including but not limited to: nitrogen, phosphorus, potassium and limestone. State recommendations for soil treatments and soil amendments to be incorporated. State recommendations in weight per 1000 sq. ft. or volume per cu. Yd.
 7. Testing for Organic Amendment Materials
 - a. Tests shall be by combined hydrometer and wet sieving in compliance with ASTM D422 after destruction of organic matter by ignition.
 - b. Test for agricultural suitability analysis as defined in Article 2.02 – Organic Amendment Materials (Compost).
- C. Samples for Verification: For each of the following:
1. Organic Mulch: 1-pint volume of each organic mulch required; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch. Each

- Sample shall be typical of the lot of material to be furnished; provide an accurate representation of color, texture, and organic makeup.
2. Mineral Mulch: 2 lb of each mineral mulch required, in sealed plastic bags labeled with source of mulch. Sample shall be typical of the lot of material to be delivered and installed on the site; provide an accurate indication of color, texture, and makeup of the material.
 3. Weed Control Barrier: 12 by 12 inches.
 4. Edging Materials and Accessories: Manufacturer's standard size, to verify color selected.
- D. Qualification Data: For qualified landscape Installer. Include list of similar projects completed by Installer demonstrating Installer's capabilities and experience. Include project names, addresses, and year completed, and include names and addresses of owners' contact persons.
- E. Product Certificates: For each type of manufactured product, from manufacturer, and complying with the following:
1. Manufacturer's certified analysis of standard products.
 2. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.
- F. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of plants during a calendar year. Submit before start of required maintenance periods.
- G. Warranty: Sample of special warranty.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified landscape Installer whose work has resulted in successful establishment of plants.
1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.
 2. Experience: Five years' experience in landscape installation in addition to requirements in Division 01 Section "Quality Requirements."
 3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
 4. Personnel Certifications: Installer's field supervisor shall have certification in one of the following categories from the Professional Landcare Network:
 - a. Certified Landscape Technician - Exterior, with installation maintenance specialty area(s), designated CLT-Exterior.
 - b. Certified Landscape Technician - Interior, designated CLT-Interior.
 - c. Certified Ornamental Landscape Professional, designated COLP.
 5. Pesticide Applicator: State licensed, commercial.
- B. Soil-Testing Laboratory Qualifications: An independent or university laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.
1. The soil-testing laboratory shall oversee soil sampling, with depth, location, and number of samples to be taken per instructions from Architect. A minimum of three representative samples shall be taken from varied locations for each soil to be used or amended for planting purposes.
- C. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1.
1. Selection of plants purchased under allowances will be made by Architect, who will tag plants at their place of growth before they are prepared for transplanting.

- D. Measurements: Measure according to ANSI Z60.1. Do not prune to obtain required sizes.
 - 1. Trees and Shrubs: Measure with branches and trunks or canes in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container grown stock. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip to tip. Take caliper measurements 6 inches above the root flare for trees up to 4-inch caliper size, and 12 inches above the root flare for larger sizes.
 - 2. Other Plants: Measure with stems, petioles, and foliage in their normal position.
 - E. Plant Material Observation: Landscape Architect may observe plant material either at place of growth or at site before planting for compliance with requirements for genus, species, variety, cultivar, size, and quality. Landscape Architect retains right to observe trees and shrubs further for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent defects and to reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.
 - 1. Notify Landscape Architect of sources of planting materials seven days in advance of delivery to site.
 - F. Preinstallation Conference: Conduct conference at Project site.
- 1.5 DELIVERY, STORAGE, AND HANDLING
- A. Planting Soils shall not be handled, hauled, or placed when wet, during or immediately after a heavy rainfall, or frozen. Soil should be handled only when the moisture content is less than or equal to the optimum water content as determined for the Standard Proctor test.
 - B. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws if applicable.
 - C. Bulk Materials:
 - 1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
 - 2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
 - 3. Accompany each delivery of bulk fertilizers, lime, and soil amendments with appropriate certificates.
 - D. Deliver bare-root stock plants freshly dug. Immediately after digging up bare-root stock, pack root system in wet straw, hay, or other suitable material to keep root system moist until planting.
 - E. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.
 - F. Handle planting stock by root ball.
 - G. Store bulbs, corms, and tubers in a dry place at 60 to 65 deg F until planting.
 - H. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.
 - 1. Heel-in bare-root stock. Soak roots that are in dry condition in water for two hours. Reject dried-out plants.

2. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
3. Do not remove container-grown stock from containers before time of planting.
4. Water root systems of plants stored on-site deeply and thoroughly with a fine-mist spray. Water as often as necessary to maintain root systems in a moist, but not overly-wet condition.

1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.
- B. Interruption of Existing Services or Utilities: Do not interrupt services or utilities to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary services or utilities according to requirements indicated:
 1. Notify Construction Manager no fewer than seven days in advance of proposed interruption of each service or utility.
 2. Do not proceed with interruption of services or utilities without Construction Manager's written permission.
- C. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion.
 1. Spring:
 - a. Deciduous materials: April 1 to June 15
 - b. Evergreen Materials: April 1 to June 15
 2. Fall:
 - a. Deciduous materials: September 1 - October 15
 - b. Evergreen Materials: September 1 - October 15
- D. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements.
- E. Coordination with Turf Areas (Lawns): Plant trees, shrubs, and other plants after finish grades are established and before planting turf areas unless otherwise indicated.
 1. When planting trees, shrubs, and other plants after planting turf areas, protect turf areas, and promptly repair damage caused by planting operations.

1.7 WARRANTY

- A. Special Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner, or incidents that are beyond Contractor's control.
 - b. Structural failures including plantings falling or blowing over.
 - c. Faulty performance of tree stabilization.
 - d. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

2. Warranty Periods from Date of Substantial Completion:
 - a. Trees, Shrubs, Vines, and Ornamental Grasses: 12 months.
 - b. Ground Covers, Biennials, Perennials, and Other Plants: 12 months.
 - c. Annuals: Three months.
3. Include the following remedial actions as a minimum:
 - a. Immediately remove dead plants and replace unless required to plant in the succeeding planting season.
 - b. Replace plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
 - c. A limit of one replacement of each plant will be required except for losses or replacements due to failure to comply with requirements.
 - d. Provide extended warranty for period equal to original warranty period, for replaced plant material.

1.8 MAINTENANCE SERVICE

- A. Initial Maintenance Service for Trees and Shrubs: Provide maintenance by skilled employees of Landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after plants are installed and continue until substantial completion but for not less than maintenance period below if substantial complete comes earlier.
 1. Maintenance Period: Three months from date of planting completion.
- B. Initial Maintenance Service for Ground Cover and Other Plants: Provide maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after plants are installed and continue until substantial completion but for not less than maintenance period below if substantial completion comes earlier.
 1. Maintenance Period: Three months from date of planting completion.
- C. Continuing Maintenance Proposal: From Installer to Owner, in the form of a standard yearly (or other period) maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

PART 2 PRODUCTS

2.1 PLANT MATERIAL

- A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant Schedule or Plant Legend shown on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.
 1. Trees with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two branches or between branch and trunk ("included bark"); crossing trunks; cut-off limbs more than 3/4 inch in diameter; or with stem girdling roots will be rejected.
 2. Collected Stock: Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated.
- B. Provide plants of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of plants required. Plants of a larger size may be used if acceptable to Landscape Architect, with a proportionate increase in size of roots or balls.
- C. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which shall begin at root flare according to ANSI Z60.1. Root flare shall be visible before planting.

- D. Labeling: Label at least one plant of each variety, size, and caliper in each planting bed with a securely attached, waterproof tag bearing legible designation of common name and full scientific name, including genus and species. Include nomenclature for hybrid, variety, or cultivar, if applicable for the plant as shown on Drawings.
- E. If formal arrangements or consecutive order of plants is shown on Drawings, select stock for uniform height and spread, and number the labels to assure symmetry in planting.
- F. Annuals: Provide healthy, disease-free plants of species and variety shown or listed, with well-established root systems reaching to sides of the container to maintain a firm ball, but not with excessive root growth encircling the container. Provide only plants that are acclimated to outdoor conditions before delivery and that are in bud but not yet in bloom.

2.2 SPADE HARVESTED AND TRANSPLANTED PLANTS

- A. Spade Harvested and Transplanted Plants shall meet all the requirements for field grown trees. Root ball diameters shall be of similar size as the ANSI Z60.1 requirement for Balled and Burlapped plants.
- B. Trees shall be harvested prior to leafing out (bud break) in the spring or during the fall planting period except for plants know to be considered as fall planting hazards. Plants that are fall planting hazards shall only be harvested prior to leafing out in the spring.
- C. Trees shall be moved and planted within 48 hours of the initial harvesting and shall remain in the spade machine until planted.

2.3 BASE LOAM

- A. Screen Loam shall be imported and shall be free of subsoil, large stones, earth clods, sticks, stumps, clay lumps, roots or other objectionable, extraneous matter or debris. Base Loam shall be from a natural source without admixture of compost, sand or any other extraneous material. Base Loam shall also be free of quack-grass rhizomes, Agropyron Repens, and the nut-like tubers of nutgrass, Cyperus Esculentus, and all other primary noxious weeds. Base Loam shall not be delivered or mixed while in a frozen or muddy condition. Base Loam for mixing shall conform to the following grain size distribution for material passing the #10 sieve:

U.S. Sieve Size	Percent Passing Minimum	Percent Passing Maximum
No. 10		100
No. 18	85	100
No. 35	70	95
No. 60	50	85
No. 140	36	63
No. 270	32	42
.002mm	3	8

- B. Maximum size shall be one-inch largest dimension. The maximum retained on the #10 sieve shall be 20% by weight of the total sample.
- C. The organic content shall be between 3.0 and 8.0 percent.
- D. The pH shall be 7.5 or less.
- E. Base Loam shall consist of fertile, friable, natural loam capable of sustaining vigorous plant growth. Loam shall be without admixture of subsoil, and refuse, resulting in a homogeneous material free of stones greater than ½" in the longest dimension, be free of lumps, plants, glass, roots, sticks, excessive stone content, debris, and extraneous matter as determined by the Landscape Architect.

- F. It shall be uncontaminated by salt water, foreign matter and substances harmful to plant growth. The maximum soluble salt index shall be 100. Base Loam shall not have levels of aluminum great than 200 parts per million.
- G. If limestone is required to amend the screened loam to bring it within a pH range of 5.5 to 7.5 no more than 200 pounds of limestone per 1,000 square feet of loam, incorporated into the soil, or 50 pounds of limestone per 1,000 square feet of loam, surface application, within a single season.
- H. The Engineer will reject any material delivered to the site that, after post-delivery testing, does not meet these specifications. If the delivered screened loam does not meet the specifications stated in this document the delivered screened loam will be removed by the contractor at the contractor's expense and at the time of rejection.
- I. The Contractor shall take representative samples of topsoil from the site and from topsoil to be hauled in and shall submit samples to a Soil Testing Laboratory for chemical analysis, and physical analysis. The Contractor shall indicate to the testing agencies that turf is to be planted and who the Owner is. The Contractor shall forward to the Owner two copies of analysis and recommendations of the testing agencies.
- J. Existing, in-place surface soil. Verify suitability of existing surface soil to produce viable base loam or lawn soil, which has been stockpiled on the site, may be used provided it can be made to comply with these Specifications herein for base loam or lawn soil.

2.4 ORGANIC AMENDMENT MATERIAL (COMPOST)

- A. Organic Material (Compost) for amending planting medium: stable, humus-like material produced from the aerobic decomposition of organic residues consisting of Leaf or Yard Waste Compost which shall have been composted for a minimum of one year (12 months). Compost shall be free of debris such as plastics, metal, concrete or other debris and stones larger than 1/2", larger branches and roots and wood chips over 1/2" in length or diameter. Compost shall be a dark brown to black color and be capable of supporting plant growth with appropriate management applicable, with no visible free water or dust, with no unpleasant odor, and meeting the following criteria as reported by laboratory tests.
 - 1. The ratio of carbon to nitrogen shall be in the range of 12:1 to 25:1.
 - 2. Stability shall be assessed by the Solvita procedure. Protocols are specified by the Solvita manual (version 4.0). The compost must achieve a maturity index of 6 or more as measured by the Solvita scale.
 - 3. Pathogens/Metals/Vector Attraction reduction shall meet all State of Connecticut requirements for applications to soils with human activity.
 - 4. Organic Content: at least 20 percent (dry weight). Organic content shall be determined by weight loss on ignition or H₂O₂ for particles passing a Number 10 sieve.
 - 5. One hundred percent of the material shall pass a 1/2-inch (or smaller) screen.
 - 6. Compost: screened to 1/2 inch maximum particle size and shall contain no more that 3 percent material finer than 0.002mm as determined by hydrometer test on ashed material.
 - 7. Debris such as metal, glass, plastic, wood (other than residual chips), asphalt or masonry shall not be visible and shall not exceed one percent dry weight.
 - 8. pH: between 6.5 to 7.2.
 - 9. Salinity: Electrical conductivity of a one to five soil to water ratio extract shall not exceed 2.0 mmhos/cm (dS/m).
 - 10. Nutrient content: determined Soil Testing Laboratory and utilized to evaluate soil required amendments for the mixed soils. Chemical analysis shall be undertaken for Nitrate Nitrogen, Ammonium Nitrogen, Phosphorus, Potassium, Calcium, Aluminum, Magnesium,

Chromium, Iron, Manganese, Lead, Soluble Salts, Cation Exchange Capacity, soil reaction (pH), buffer pH, and micronutrients.

2.5 SAND

A. Sand as Amendment for Soil Mediums and for Drainage.

1. Sand shall be uniformly graded medium to coarse sand consisting of clean, inert, rounded grains of quartz or other durable rock and free from loam or clay, surface coatings, mica, other deleterious materials with the following gradation. Calcitic sand is not permitted.

U.S. Sieve Size	Percent Passing Minimum	Percent Passing Maximum
No. 10	100	--
No. 18	65	90
No. 35	35	60
No. 60	15	30
No. 140	0	8
No. 270	0	3
.002mm	0	0.5

- B. Maximum size shall be one inch largest dimension. The maximum retained on the #10 sieve shall be 15% by weight of the total sample.
- C. The ratio of the particle size for 70% passing (D70) to the particle size for 20% passing (D20) shall be 3.0 or less. (D70/D20 <3.0)
- D. Saturated hydraulic conductivity of the sand shall be not less than 30 inches per hour, according to ASTM D5856-95 (2000), when compacted to a minimum of 90% Standard Proctor, ASTM 698.
- E. The pH shall be 7.5 or less.

2.6 PLANTING SOIL

- A. Base Loam, Sand and Compost, each as specified above, shall be combined in an approximate mix ratio of one part by volume Sand to one and one half parts by volume Base Loam to one part by volume Compost (1S:1.5L:1C) to create a uniform blend which meets the following requirements.
- B. Gradation for Material Passing the Number 10 Sieve:

U.S. Sieve Size	Percent Passing Minimum	Percent Passing Maximum
No. 10	100	--
No. 18	70	95
No. 35	46	74
No. 60	30	56
No. 140	17	26
No. 270	14	18
.002mm	1	2

1. Maximum size shall be one-inch largest dimension. The maximum retained on the #10 sieve shall be 15% by weight of the total sample.
2. Ratio of the particle size for 80% passing (D80) to the particle size for 30% passing (D30) shall be 8 or less. (D80/D30 <8)

3. Saturated hydraulic conductivity of the mix: not less than 2 inches per hour according to ASTM D5856-95 (2000) when compacted to a minimum of 84% Standard Proctor, ASTM 698.
4. Organic content: between 5.0 and 7.0 percent by weight.
5. The pH of the mix shall be between 6.5 and 7.0.

2.7 INORGANIC SOIL AMENDMENTS

- A. Lime: ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:
 1. Class: T, with a minimum of 99 percent passing through No. 8 sieve and a minimum of 75 percent passing through No. 60 sieve.
 2. Class: O, with a minimum of 95 percent passing through No. 8 sieve and a minimum of 55 percent passing through No. 60 sieve.
 3. Provide lime in form of ground dolomitic limestone or calcitic limestone depending on recommendations from soil analysis.
- B. Sulfur: Granular, biodegradable, and containing a minimum of 90 percent sulfur, with a minimum of 99 percent passing through No. 6 sieve and a maximum of 10 percent passing through No. 40 sieve.
- C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.
- D. Aluminum Sulfate: Commercial grade, unadulterated.
- E. Perlite: Horticultural perlite, soil amendment grade.
- F. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through No. 50 sieve.
- G. Diatomaceous Earth: Calcined, 90 percent silica, with approximately 140 percent water absorption capacity by weight.
- H. Zeolites: Mineral clinoptilolite with at least 60 percent water absorption by weight.

2.8 FERTILIZERS

- A. Bonemeal: Commercial, raw or steamed, finely ground; a minimum of 1 percent nitrogen and 10 percent phosphoric acid.
- B. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.
- C. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
 1. Composition: 1 lb/1000 sq. ft. of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.
 2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.
- D. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
 1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.
 2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

- E. Planting Tablets: Tightly compressed chip type, long-lasting, slow-release, commercial-grade planting fertilizer in tablet form. Tablets shall break down with soil bacteria, converting nutrients into a form that can be absorbed by plant roots.
 - 1. Size: 5-gram tablets.
 - 2. Nutrient Composition: 20 percent nitrogen, 10 percent phosphorous, and 5 percent potassium, by weight plus micronutrients.
- F. Chelated Iron: Commercial-grade FeEDDHA for dicots and woody plants, and commercial-grade FeDTPA for ornamental grasses and monocots.

2.9 MULCHES

- A. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:
 - 1. Type: Aged double-shredded bark.
 - 2. Size Range: 2 inches maximum, 1/2 inch minimum.
 - 3. Color: Natural.
 - 4. Depth as called for on the drawings.

2.10 WEED-CONTROL BARRIERS

- A. Woven polypropylene fabric, needle punched, 4 oz./sq. yd. minimum, composed of fibers formed into a stable network so that fibers retain their relative position. Fabric shall be inert to biological degradation and resist naturally-encountered chemicals, alkalis, and acids.
- B. Physical properties:

Mechanical Properties	Test Method	Unit	Minimum Average Roll Value
Weight	ASTM D3776	oz/yd ²	4
Grab Tensile Strength, Ultimate	ASTM D 4632	Pounds	95
Grab Tensile Strength, Elongation at Ultimate	ASTM D 4632	Percent (%)	12
Trapezoid Tear Strength	ASTM D 4533	Pounds	35
Mullen Burst Strength	ASTM D 3786	psi	240
Puncture Strength	ASTM D 4833	Pounds	55
Flow Rate	ASTM D 4491	gal/min/ft ²	15
UV Resistance (at 2500 hours)	ASTM D 4355	% strength retained	70
Thickness	ASTM D 5199	Mils (mm)	24

- C. To be installed in all planting beds and in tree rings between soil and mulch.

2.11 PESTICIDES

- A. General: Pesticide registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.
- B. Pre-Emergent Herbicide (Selective and Non-Selective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.
- C. Post-Emergent Herbicide (Selective and Non-Selective): Effective for controlling weed growth that has already germinated.

2.12 TREE STABILIZATION MATERIALS

A. Stakes and Guys:

1. Upright and Guy Stakes: Rough-sawn, sound, new hardwood or softwood with specified wood pressure-preservative treatment, free of knots, holes, cross grain, and other defects, 2-by-2-inch nominal by length indicated, pointed at one end.
2. Wood Deadmen: Timbers measuring 8 inches in diameter and 48 inches long, treated with specified wood pressure-preservative treatment.
3. Flexible Ties: Wide rubber of length required to reach stakes or turnbuckles.
4. Guys and Tie Wires: ASTM A 641/A 641M, Class 1, galvanized-steel wire, two-strand, twisted, 0.106 inch in diameter.
5. Tree-Tie Webbing: UV-resistant polypropylene or nylon webbing with brass grommets.
6. Guy Cables: Five-strand, 3/16-inch- diameter, galvanized-steel cable, with zinc-coated turnbuckles, a minimum of 3 inches long, with two 3/8-inch galvanized eyebolts.
7. Flags: Standard surveyor's plastic flagging tape, white, 6 inches long.

2.13 MISCELLANEOUS PRODUCTS

- A. Wood Pressure-Preservative Treatment: AWWPA C2, with waterborne preservative for soil and freshwater use, acceptable to authorities having jurisdiction, and containing no arsenic; including ammoniacal copper arsenate, ammoniacal copper zinc arsenate, and chromated copper arsenate.
- B. Antidesiccant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees and shrubs. Deliver in original, sealed, and fully labeled containers and mix according to manufacturer's written instructions.
- C. Burlap: Non-synthetic, biodegradable.
- D. Mycorrhizal Fungi: Dry, granular inoculant containing at least 5300 spores per lb of vesicular-arbuscular mycorrhizal fungi and 95 million spores per lb of ectomycorrhizal fungi, 33 percent hydrogel, and a maximum of 5.5 percent inert material.

2.14 WATER

- A. Water: furnished by Contractor, unless otherwise specified, and suitable for irrigation and free from ingredients harmful to plant life. Hose and other watering equipment furnished by Contractor.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive plants for compliance with requirements and conditions affecting installation and performance.
 1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
 2. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.
 3. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
 4. Uniformly moisten excessively dry soil that is not workable and which is too dusty.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.

3.2 GENERAL PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.
- B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
- C. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain Architect's acceptance of layout before excavating or planting. Make minor adjustments as required.
- D. Lay out plants at locations directed by Architect. Stake locations of individual trees and shrubs and outline areas for multiple plantings.
- E. Apply antidesiccant to trees and shrubs using power spray to provide an adequate film over trunks (before wrapping), branches, stems, twigs, and foliage to protect during digging, handling, and transportation.
 - 1. If deciduous trees or shrubs are moved in full leaf, spray with antidesiccant at nursery before moving and again two weeks after planting.
- F. Wrap trees and shrubs with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during digging, handling, and transportation.
- G. Unchanged Subgrades: If plants are to be planted in areas unaltered or undisturbed by excavating, grading, or surface-soil stripping operations, prepare surface soil as follows:
 - 1. Remove existing grass, vegetation, and turf in areas called for on the drawings. Do not mix into surface soil.
 - 2. Loosen surface soil to a depth of at least 18 inches. Apply soil amendments and fertilizers according to test reports and mix thoroughly into top 6 inches of soil. Till soil to a homogeneous mixture of fine texture.
 - 3. Apply superphosphate fertilizer directly to surface soil before loosening.
 - 4. Remove stones larger than 1 inch in any dimension and sticks, roots, trash, and other extraneous matter.
 - 5. Legally dispose of waste material, including grass, vegetation, and turf, off Owner's property.

3.3 PREPARATION OF PLANTING SOILS

- A. Correct deficiencies in soil as directed by soil test results. Thoroughly incorporate amendments into planting mixture to ensure even distribution.

3.4 DECOMPACTION OF PLANTING AREAS

- A. All subgrade areas to receive planting soils, shall be loosened to a minimum depth of eighteen inches utilizing the bucket of an excavator or approved equivalent equipment.
- B. After the soils have been loosened, Planting Soils may be spread by using a wide-track bulldozer size D-5 or smaller or may be dumped and spread with the bucket of a backhoe from the edge of the loosened area. No rubber-tired equipment or heavy equipment except for a small bulldozer shall pass over the subsoils (subgrade) after they have been loosened. If Contractor plans to utilize such areas for use of heavy equipment, this work should be carried out prior to beginning the process of loosening soils or filling in that area, or it will have to be re-scarified and meet this specification requirement.

3.5 PLACEMENT OF PLANTING SOIL

- A. After approval of subgrade, place and spread planting soil in lifts not greater than twelve inches and compact with a minimum of three passes of the tracks of a bulldozer to a density between 83 and 86 percent Standard Proctor Maximum Dry Density.

- B. Place and spread planting medium to a depth greater than required such that after settlement, finished grade conforming to the lines, grades and elevations shown on the Drawings. Ensure proper drainage in an uninterrupted pattern free of hollows and pockets.
- C. Remove stiff clods, lumps, brush, roots, stumps, litter and other foreign material and stones over one inch in diameter and dispose of legally off site.
- D. Smoothly round-off all top and toe of slopes. Reinstall erosion control devices and protective fencing as required.
- E. Determine the bulk density of the topsoil prior to approval of finish grade, using an approximate method outlined in C.A. Black (ed) Methods of Soil Analysis, Part 1, American Society of Agronomy, 1965. Final bulk density of the topsoil shall have a mean value of approximately 1.35 g cm⁻³ (85 lbs. per cu. ft) taken from 5 samples from each field with no value exceeding 1.40 g cm⁻³ (88 lbs. per cu. ft.).

3.6 FIELD QUALITY CONTROL

- A. Confirm that the subgrade is at the proper elevation and that no further earthwork is required to bring the subgrade to proper elevations. Subgrade layer elevations shall slope parallel to the finished grade as shown on the Contract Documents. Provide a written report to the Owner's Representative and the Owner's Representative that the subgrade has been adjusted to the required elevations to provide a uniform thickness of planting media across the area. Perform no work of placing and spreading soil until elevations have been confirmed and written report has been accepted by the Owner's Representative.
- B. As provided in Part 1.7 – Project Conditions, No Base Materials or Soil Medium and no subgrade materials shall be handled, planted in any way if it is in a wet or frozen condition. A moist Soil Medium is desirable for planting.

3.7 PLANTING AREA ESTABLISHMENT

- A. Apply superphosphate fertilizer directly to subgrade before loosening.
 - 1. Spread planting soil to a depth of 12 inches but not less than required to meet finish grades after natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.
- B. Before planting, obtain Landscape Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.
- C. Application of Mycorrhizal Fungi: As recommended by manufacturer.

3.8 EXCAVATION FOR TREES AND SHRUBS

- A. Planting Pits and Trenches: Excavate circular planting pits with sides sloping inward at a 45-degree angle. Excavations with vertical sides are not acceptable. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.
 - 1. Excavate approximately three times as wide as ball diameter for balled and burlapped stock.
 - 2. Excavate at least 12 inches wider than root spread and deep enough to accommodate vertical roots for bare-root stock.
 - 3. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball.
 - 4. If area under the plant was initially dug too deep, add soil to raise it to the correct level and thoroughly tamp the added soil to prevent settling.
 - 5. Maintain required angles of repose of adjacent materials as shown on the Drawings. Do not excavate subgrades of adjacent paving, structures, hardscapes, or other new or existing improvements.

6. Maintain supervision of excavations during working hours.
 7. Keep excavations covered or otherwise protected when unattended by Installer's personnel.
 8. If drain tile is shown on Drawings or required under planting areas, excavate to top of porous backfill over tile.
- B. Subsoil and topsoil removed from excavations may not be used as planting soil.
- C. Obstructions: Notify Landscape Architect if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.
1. Hardpan Layer: Drill 6-inch- diameter holes, 24 inches apart, into free-draining strata or to a depth of 10 feet, whichever is less, and backfill with free-draining material.
- D. Drainage: Notify Architect if subsoil conditions evidence unexpected water seepage or retention in tree or shrub planting pits.
- E. Fill excavations with water and allow to percolate away before positioning trees and shrubs.

3.9 TREE, SHRUB, AND VINE PLANTING

- A. Before planting, verify that root flare is visible at top of root ball according to ANSI Z60.1. If root flare is not visible, remove soil in a level manner from the root ball to where the top-most root emerges from the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements.
- B. Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.
- C. Set balled and burlapped stock plumb and in center of planting pit or trench with root flare flush with adjacent finish grades.
1. Use planting soil for backfill.
 2. After placing some backfill around root ball to stabilize plant, carefully cut and remove burlap, rope, and wire baskets from tops of root balls and from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
 3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
 4. Place planting tablets in each planting pit when pit is approximately one-half filled; in amounts recommended in soil reports from soil-testing laboratory. Place tablets beside the root ball about 1 inch from root tips; do not place tablets in bottom of the hole.
 5. Continue backfilling process. Water again after placing and tamping final layer of soil.
- D. Set container-grown stock plumb and in center of planting pit or trench with root flare flush with adjacent finish grades.
1. Use planting soil for backfill.
 2. Carefully remove root ball from container without damaging root ball or plant.
 3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
 4. Place planting tablets in each planting pit when pit is approximately one-half filled; in amounts recommended in soil reports from soil-testing laboratory. Place tablets beside the root ball about 1 inch from root tips; do not place tablets in bottom of the hole.
 5. Continue backfilling process. Water again after placing and tamping final layer of soil.

- E. Set and support bare-root stock in center of planting pit or trench with root flare flush with adjacent finish grade.
 - 1. Use planting soil for backfill.
 - 2. Spread roots without tangling or turning toward surface, and carefully work backfill around roots by hand. Puddle with water until backfill layers are completely saturated. Plumb before backfilling, and maintain plumb while working backfill around roots and placing layers above roots.
 - 3. Place planting tablets in each planting pit when pit is approximately one-half filled; in amounts recommended in soil reports from soil-testing laboratory. Place tablets beside soil-covered roots about 1 inch from root tips; do not place tablets in bottom of the hole or touching the roots.
 - 4. Continue backfilling process. Water again after placing and tamping final layer of soil.
- F. When planting on slopes, set the plant so the root flare on the uphill side is flush with the surrounding soil on the slope; the edge of the root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of the root ball.

3.10 SPADE HARVESTED AND TRANSPLANTED PLANTS

- A. After installing the tree, loosen the soil along the seam between the root ball and the surrounding soil out to a radius from the root ball edge equal to the diameter of the root ball to a depth of 8 - 10 inches by hand digging to disturb the soil interface.
- B. Fill any gaps below this level with loose soil.
- C. After installing the tree, loosen the soil along the seam between the root ball and the surrounding soil out to a radius from the root ball edge equal to the diameter of the root ball to a depth of 8 - 10 inches by hand digging to disturb the soil interface.

3.11 TREE, SHRUB, AND VINE PRUNING

- A. Remove only dead, dying, or broken branches. Do not prune for shape.
- B. Prune, thin, and shape trees, shrubs, and vines as directed by Architect.
- C. Prune, thin, and shape trees, shrubs, and vines according to standard professional horticultural and arboricultural practices. Unless otherwise indicated by Architect, do not cut tree leaders; remove only injured, dying, or dead branches from trees and shrubs; and prune to retain natural character.
- D. Do not apply pruning paint to wounds.

3.12 TREE STABILIZATION

- A. Install trunk stabilization as follows unless otherwise indicated:
 - 1. Upright Staking and Tying: Stake trees of 2- through 5-inch caliper. Stake trees of less than 2-inch caliper only as required to prevent wind tip out. Use a minimum of two stakes of length required to penetrate at least 18 inches below bottom of backfilled excavation and to extend to the dimension shown on Drawings above grade. Set vertical stakes and space to avoid penetrating root balls or root masses.
 - 2. Use two stakes for trees up to 12 feet high and 2-1/2 inches or less in caliper; three stakes for trees less than 14 feet high and up to 4 inches in caliper. Space stakes equally around trees.
 - 3. Support trees with bands of flexible ties at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree.
 - 4. Support trees with two strands of tie wire, connected to the brass grommets of tree-tie webbing at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree.

- B. Staking and Guying: Stake and guy trees more than 6 feet in height and more than 2 1/2 inches in caliper unless otherwise indicated. Securely attach no fewer than three guys to stakes 30 inches long, driven to grade.
 - 1. Site-Fabricated Staking-and-Guying Method:
 - a. For trees more than 6 inches in caliper, anchor guys to wood deadmen buried at least 36 inches below grade. Provide turnbuckle for each guy wire and tighten securely.
 - b. Support trees with bands of flexible ties at contact points with tree trunk and reaching to turnbuckle. Allow enough slack to avoid rigid restraint of tree.
 - c. Support trees with strands of cable or multiple strands of tie wire, connected to the brass grommets of tree-tie webbing at contact points with tree trunk and reaching to turnbuckle. Allow enough slack to avoid rigid restraint of tree.
 - d. Attach flags to each guy wire, 30 inches above finish grade.
 - e. Paint turnbuckles with luminescent white paint.
 - 2. Proprietary Staking and Guying Device: Install staking and guying system sized and positioned as recommended by manufacturer unless otherwise indicated and according to manufacturer's written instructions.
- C. Root-Ball Stabilization: Install at- or below-grade stabilization system to secure each new planting by the root ball unless otherwise indicated.
 - 1. Wood Hold-Down Method: Place vertical stakes against side of root ball and drive them into subsoil; place horizontal wood hold-down stake across top of root ball and screw at each end to one of the vertical stakes.
 - a. Install stakes of length required to penetrate at least to the dimension shown on Drawings below bottom of backfilled excavation. Saw stakes off at horizontal stake.
 - b. Install screws through horizontal hold-down and penetrating at least 1 inch into stakes. Pre-drill holes if necessary to prevent splitting wood.
 - c. Install second set of stakes on other side of root trunk for larger trees as indicated.
 - 2. Proprietary Root-Ball Stabilization Device: Install root-ball stabilization system sized and positioned as recommended by manufacturer unless otherwise indicated and according to manufacturer's written instructions.

3.13 GROUND COVER AND PLANT PLANTING

- A. Set out and space ground cover and plants other than trees, shrubs, and vines as indicated in even rows with triangular spacing.
- B. Use planting soil for backfill.
- C. Dig holes large enough to allow spreading of roots.
- D. For rooted cutting plants supplied in flats, plant each in a manner that will minimally disturb the root system but to a depth not less than two nodes.
- E. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.
- F. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.
- G. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.14 PLANTING AREA MULCHING

- A. Install weed-control barriers before mulching according to manufacturer's written instructions. Completely cover area to be mulched, overlapping edges a minimum of 6 inches and secure seams with galvanized pins.
- B. Mulch backfilled surfaces of planting areas and other areas indicated.

1. Trees in Turf Areas: Apply organic mulch ring of 3-inch average thickness, with 24-inch radius around trunks or stems. Do not place mulch within 3 inches of trunks or stems.
2. Organic Mulch in Planting Areas: Apply 3-inch average thickness of organic mulch extending 12 inches beyond edge of individual planting pit or trench and over whole surface of planting area, and finish level with adjacent finish grades. Do not place mulch within 3 inches of trunks or stems.

3.15 PLANT MAINTENANCE

- A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing tree-stabilization devices, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings. Spray or treat as required to keep trees and shrubs free of insects and disease.
- B. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.
- C. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

3.16 PESTICIDE APPLICATION

- A. Apply pesticides and other chemical products and biological control agents in accordance with authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.
- B. Pre-Emergent Herbicides (Selective and Non-Selective): Apply to tree, shrub, and ground-cover areas in accordance with manufacturer's written recommendations. Do not apply to seeded areas.
- C. Post-Emergent Herbicides (Selective and Non-Selective): Apply only as necessary to treat already-germinated weeds and in accordance with manufacturer's written recommendations.

3.17 CLEANUP AND PROTECTION

- A. During planting, keep adjacent paving and construction clean and work area in an orderly condition.
- B. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.
- C. After installation and before Substantial Completion, remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.

3.18 DISPOSAL

- A. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.

END OF SECTION 32 9300

SECTION 33 1100
WATER SUPPLY SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions, are hereby made a part of this Section.

1.2 SUMMARY

- A. This Section specifies requirements for the proposed water system pipe, fittings appurtenances and services.
- B. The work includes:
 - 1. Furnishing and installation of water distribution pipe, valves and valve boxes, pipe fittings, anchors, thrust blocks, required accessories and connections to existing water systems.
 - 2. Disinfection and testing of the system.
 - 3. Related Sections
- C. Related Work: The following Sections contain work related to this Section:
 - 1. Section 31 0130 Earthwork

1.3 COORDINATION WITH THE MUNICIPALITY

- A. The Onset Fire District Water Department (the District) shall be notified prior to starting construction.
- B. Perform all work in accordance with the latest edition of the Onset Fire District Onset Water Department Rules and Regulations, which are made a part of this Specification by reference. In the case of any conflict between this Specification and the District's Rules and Regulations, the District's requirements shall prevail.
- C. Submit an Application for Water Service with the District as required by their Rules and Regulations, pay all required connection and application fees.
- D. The closing of valves necessary for making connections with existing system will be done by the appropriate District staff. Sufficient notice shall be given the District of planned connection. No allowance will be made for any delay in closing of valves. A 48-hour notice shall be given to residents or businesses affected by the shutdown, and shall be done by the Contractor under the direction of the Engineer.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. Submit Shop Drawings or descriptive literature, or both, showing dimensions, joints and other details of all materials to be furnished. Shop Drawings shall be submitted to the Engineer for approval prior to ordering materials.
- B. As-Built Drawings:
 - 1. Submit 5 copies of As-Built Drawings upon completion and acceptance of work.
 - 2. As-Built Drawings shall be complete and shall indicate the true measurements and locations, horizontal and vertical, of all new construction. As-Built Drawings shall include a minimum of three ties to each gate valve box from fixed permanent objects. As-Built Drawings shall also contain any additional information required by the municipality, and shall be stamped with the seal of a Licensed Land Surveyor and Licensed Professional Engineer.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Storage of pipe, fittings, valves and other water line appurtenances on the site shall be in accordance with the manufacturer's recommendations, subject to the approval of the Engineer.
- B. Care shall be taken in loading, transporting and unloading to prevent injury to the pipe, fittings, valves and other water line appurtenances. Pipe or fittings shall not be dropped. All pipe or fittings shall be examined before laying and no piece shall be installed which is found to be defective. Any damage to pipe and fitting coatings shall be repaired as directed by the Engineer.
- C. Pipe, fittings, valves and other water system appurtenances which are defective from any cause, including damage caused by handling, and determined by the Engineer as unrepairable, shall be unacceptable for installation and shall be replaced at no cost to the Owner.
- D. Pipe and all water system appurtenances that are damaged or disturbed through any cause prior to acceptance of the work shall be repaired, realigned or replaced as required by the Engineer at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 GENERAL

- A. The Drawings are diagrammatic only and are intended to indicate the extent, but not all details, of the system which shall be constructed. All materials are not shown; but the Contractor shall furnish and install all materials required for the complete system.

2.2 DUCTILE IRON PIPE

- A. Ductile iron pipe shall be designed in accordance with ANSI A21.50/AWWA C150 and manufactured in accordance with ANSI A21.51/AWWA C151. Fittings shall be either mechanical joint or push-on joint complying with ANSI/AWWA C110/A21.10 or ANSI/AWWA C111/A21.11.
- B. Ductile iron pipe shall be Pressure Class 52 furnished in 18-foot or 20-foot nominal lengths.
- C. Restrained joint assemblies for mechanical fittings shall be EBAA Iron Sales MEGALUG or approved equivalent.
- D. Pipes shall be cement-mortar lined in accordance with ANSI A21.4/AWWA C104, except that the cement lining shall be double thickness.
- E. The exterior of all pipe shall be factory coated, with a double coat of asphaltic material conforming to ANSI A21.51/AWWA C151. The interior of all pipe shall have a seal coat of asphaltic material applied over the cement lining in accordance with ANSI A21.4/AWWA C104

2.3 DUCTILE IRON PIPE FITTINGS

- A. All ductile iron pipe fittings shall conform to ANSI/AWWA C110/A21.10.
- B. The type of fittings for pipe and valve connections shall be determined by the Contractor in accordance with the requirements shown on the Drawings prior to ordering the fittings.
- C. All fittings shall be cement-mortar lined and coated as specified for pipe.

2.4 DUCTILE IRON PIPE COUPLINGS

- A. Couplings and accessories shall be pressure rated at least equal to that of the pipe. Couplings shall be Dresser Style 153, Smith Blair 441 style or approved equivalent. The couplings shall be provided with corrosion resistant nuts and bolts.
- B. Transition couplings for joining pipe of different diameters shall be Dresser Style 162 or approved equivalent. Coupling shall be provided with corrosion resistant nuts and bolts.

- C. After assembly, all exterior surfaces including the bolts and nuts shall be completely coated with two coats of a heavy-duty protective asphaltic coating. The interior of the coupling shall be epoxy-coated. Epoxy coating shall conform to AWWA C550.

2.5 DUCTILE IRON PIPE JOINTS

- A. Joints shall be either push-on or mechanical joints conforming to ANSI A21.11/AWWA C111. Push-on and mechanical joints shall be provided with required gaskets, lubricants and accessories conforming to ANSI A21.11/AWWA C111.

2.6 COPPER PIPE

- A. Services two inches or smaller shall be copper water tubing, Type K, for underground water service and shall be in accordance with ANSI/AWWA C800.
- B. Water service fittings including couplings and adapters, check valves and service saddles shall be in conformance with ANSI/AWWA C800, Underground Service Line Valves and Fittings.
- C. Joints in copper tubing shall be made with three-part compression couplings or an approved equal.

2.7 THRUST BLOCKS

- A. Thrust restraints [cement concrete thrust blocks and/or clamps and tie rods] shall be installed in accordance with the details shown on the Drawings and as required by the Engineer.
- B. The Contractor shall discuss with the Engineer the method[s] to be used to restrain thrust prior to installing fittings and hydrant. Test pits may be required in areas of existing utilities to determine the exact location and dimensions of thrust restraints required.
- C. Concrete for thrust blocks shall have a minimum 28-day comprehensive strength of 3,000-psi.

2.8 GATE VALVES

- A. AWWA C509, Iron body, bronze trim, non-rising stem with square nut, single wedge, resilient seat, mechanical joint ends, control rod and extension box with box cover.

2.9 VALVE BOXES

- A. Each gate valve shall be provided with a valve box and cover.
- B. Valve boxes shall be of the adjustable, telescoping, heavy-pattern type designed and constructed to prevent the direct transmission of traffic loads to the pipe or valve.
- C. Valve boxes shall be cast iron, asphalt coated with cast iron covers. The smallest inside diameter of the shaft shall not be less than 5-1/4 inches. The lower section of the box shall be designed to enclose the operating nut and stuffing box of the valve. Provisions shall be made for adjustment through at least 6-inches vertically while retainage lap of at least 4 inches between sections.
- D. Covers shall be close fitting and substantially dirt-tight. The top of the cover shall be flush with the top of the box rim. The word Water [or other as required by the District] shall be cast in the top surface of the cover.

2.11 HYDRANTS

- A. Hydrants shall be M&H model 929 or equal and shall conform to the "Standard Specification for Fire Hydrants for Ordinary Water Service," AWWA C502. Contractor shall check with the Onset Fire District Onset Water Department to ensure that all hydrants used conform to Water Works standards.
- B. Hydrant Extensions: Fabricate in multiples of 6 inches with rod and coupling to increase barrel length

2.12 TAPPING SLEEVE AND VALVE

- A. Tapping sleeves shall meet the requirements of AWWA C500. The valves shall be provided with oversized seat rings to permit the use of full size tapping machine cutters.

2.13 CORPORATION STOPS AND CURB STOPS

- A. Corporation stops shall be Mueller 300 ball type corporation valves threaded to receive compression-type fitting, or approved equivalent.
- B. Curb stops shall be Mueller 300 ball valve curb stop or approved equivalent, threaded to receive compression-type fittings.
- C. Stops shall be sized to receive the service tubing without the use of enlargement/reduction fittings.

2.14 SERVICE BOXES

- A. Service boxes shall be cast iron improved extension type with arch pattern base. Covers shall be held in place with bronze bolts and the word Water shall be cast into the top surface of the cover. Service box shafts shall have a minimum inside diameter of 2-1/2 inches. Service boxes shall be as manufactured by Mueller Corp. or approved equivalent.
- B. Covers shall be close fitting and substantially dirt-tight. The top of the cover shall be flush with the top of the box rim. The word Water [or other as required by the District] shall be cast in the top surface of the cover.

PART 3 - EXECUTION

3.1 GENERAL

- A. All water pipes, fittings, valves, hydrants and other appurtenances shall be installed at the locations as shown on the Drawings.
- B. The proposed location, and vertical alignment may be altered to avoid conflicts with existing and proposed utilities, as approved by the Engineer.

3.2 LAYING DUCTILE IRON PIPE AND FITTINGS

- A. Ductile iron pipe and fittings shall be installed in accordance with the requirements of ANSI/AWWA C600.
- B. Each length of pipe shall be laid with firm, full and even bearing throughout its entire length, in a trench prepared and maintained in accordance with Section 31 01 30, Earthwork.
- C. All pipe shall be clean before laying. When laying is stopped for any reason, the open ends of the pipe shall be closed by watertight plugs or other approved means. If water is in the trench when work is resumed, the plug shall not be removed until the trench has been dewatered and all danger of water entering the pipe has been eliminated.
- D. Fittings, in addition to those shown on the Drawings, shall be provided if required to avoid utility conflicts.
- E. When cutting of pipe is required, the cutting shall be done by machine, leaving a smooth cut at right angles to the axis of the pipe. Cut ends of pipe to be used with a push-on bell shall be beveled to conform to the manufactured spigot end. Cement lining shall be undamaged.
- F. Maximum allowable deflection for pipe laid without fittings shall not exceed the allowable amount established by the pipe manufacturer and shall not exceed those shown in AWWA C600.
- G. The pipe shall be laid with a minimum cover of five (5) feet below finished grade.

3.3 JOINTING DUCTILE IRON PIPE [PUSH-ON TYPE]

- A. Push-on joints shall be made in strict accordance with the manufacturer's instructions. A rubber gasket shall be inserted in the groove of the bell end of the pipe and the joint surface cleaned and lubricated using the pipe manufacturer's suggested methods and materials.

The plain end of the pipe to be laid shall be inserted in alignment with the bell of the pipe to which it is to be jointed and pushed home with a jack or by other means. After joining the pipe, a metal feeler gauge shall be used to make certain that the rubber gasket is correctly located and has not been twisted or otherwise displaced.

3.4 JOINTING MECHANICAL JOINT PIPE AND FITTINGS

- A. Mechanical joints shall be made in strict accordance with the manufacturer's instructions. Mechanical joints shall be made by first cleaning the surfaces against which the gaskets will come in contact with a wire brush. The gasket, bell, and spigot shall be lubricated by washing with soapy water just prior to assembling the joint. After the nuts have been made up finger tight, the bottom nut, then top and then diametrically opposite nuts shall be progressively tightened. Bolts shall be tightened to the torques listed:

Bolt Size [Inches]	Range of Torque [Feet-Pounds]
5/8	45 - 60
3/4	75 - 90
1 inch	85 - 100

- B. Under no conditions shall extension wrenches or a pipe over the handle of an ordinary ratchet wrench be used to secure greater leverage. After installation, a heavy bitumastic coating shall be applied to all bolts and nuts.
- C. Restraining device shall be ductile iron and shall have dimensions such that it can be used with the standardized mechanical joint bell and tee-head bolts conforming to ANSI/AWWA Z21.11 and ANSI/AWWA C153 latest revision.

3.5 CONCRETE THRUST BLOCKS

- A. Where pipes change horizontal and vertical direction, at hydrants, tees and other fittings, and wherever abnormal thrust forces may be developed, the Contractor shall construct thrust and anchor blocks as detailed on the Drawings. They shall be concrete, of minimum dimensions as detailed on the Drawings or of adequate additional size to suit actual conditions to withstand pressures anticipated, and shall be founded in undisturbed soil.
- B. Concrete for thrust blocks shall have a minimum 28 day's compressive strength of 3,000 psi.
- C. Fittings which do not use thrust blocks resting against natural occurring material with passive resistance pressure of 1,500 psf shall be installed with a restrained joint system as specified in Article 3.6.

3.6 RESTRAINED JOINTS

- A. Pipe with restrained joints shall be installed at locations shown on the Drawings. Restrained joints shall be installed at bends, reducers, tees, valves, dead ends, and hydrants. The minimum length of pipe to be restrained on either side of the joint shall be as shown on the table below. The fittings of the new piping shall be for restrained joints, as marked on the Drawings.

Number of Joints to Restraint
 on Either Side of Fitting

Fitting	Number of Joints to Restraint on Either Side of Fitting [Based on 18-Foot Pipe Length]
90 degree bend	3
45 degree bend	2
22-1/2 degree bend	2
Tee:	
Branch	3
Run	2

- B. No restraining is required in the direction of the existing pipe if only a short length of it is exposed in the trench for making a connection.
- C. Restrained joint assemblies for push-on pipe and fittings shall be made in strict accordance with the manufacturer's recommended installation procedures.
- D. Restrained joint assemblies for mechanical joint pipe shall be EBAA Iron Sales MEGALUG or approved equivalent.

3.7 WATER/SEWER SEPARATION

When a sewer pipe crosses above or below a water pipe, the following procedures shall be utilized. The Contractor shall comply with these following procedures:

- A. Relation to Water Mains:
 - 1. *Horizontal Separation:* Whenever possible sewers shall be laid at a minimum at least 10 feet, horizontally, from any existing or proposed water main. Should local conditions prevent a lateral separation of 10 feet, a sewer may be laid closer than 10 feet to a water main if:
 - a. It is laid in a separate trench, or if
 - b. It is laid in the same trench with the water mains located at one side on a bench of undistributed earth, and if
 - c. If either case the elevations of the top (crown) of the sewer is at least 18 inches below the bottom (invert) of the water main.
 - 2. *Vertical Separation:* Whenever sewers must cross under water mains, the sewer shall be laid at such an elevation that the top of the sewer is at least 18 inches below the bottom of the water main. When the elevation of the sewer cannot be varied to meet the above requirements, the water main shall be relocated to provide this separation or reconstructed with mechanical-joint pipe for a distance of 10 feet on each side of the sewer. One full length of water main should be centered over the sewer so that both joints will be as far from the sewer as possible.
- B. When it is impossible to obtain horizontal and/or vertical separation as stipulated above, both the water main and sewer shall be constructed of mechanical-joint cement lined ductile iron pipe or other equivalent based on water tightness and structural soundness. Both pipes shall be pressure tested by an approved method to assure water tightness or both pipes shall be encased in concrete.

3.8 LAYING COPPER PIPE

- A. Care shall be exercised in placing and laying of services to prevent kinks or sharp bends and contact with sharp stones or ledge which would damage the pipe. At least 6 inches of sand shall be placed adjacent to, under, and above the pipe, and no stone larger than 2

inches shall be placed over the pipe until the depth of backfill above the pipe is in excess of 1 foot.

3.9 PRESSURE TESTING

- A. Hydrostatic and leakage test shall be conducted in accordance with AWWA Standard C600, and as directed by the Engineer. Testing shall be conducted by a certified independent water testing company.
- B. Conduct pipe tests after concrete thrust blocks have cured to the required 3000 psi strength. Fill pipe 24 hours prior to testing, and apply test pressure to stabilize system. Use only potable water.
- C. Prior to pressure testing, the entire pipe section shall be flushed to remove any rocks or debris which may have inadvertently entered the pipe during construction.
- D. Once the pipe section has been filled at normal pressure and all entrapped air removed, the Contractor shall raise the pressure to 150 psi or two times the operating pressure (whichever is greater) by a special pressure pump, taking water from a small tank of proper dimensions for satisfactorily measuring the rate of pumpage into the pipe. This pressure shall be maintained for a minimum of 2 hours, during which time the line shall be checked for leaks. Measured rate of water leakage shall not exceed the allowable leakage listed below.

Allowable leakage in gallons per hour, per 1,000 feet of exterior pipeline:

Test Pressure	Nominal Pipe Diameter [inches]					
	4	6	8	10	12	16
150 psi	0.36	0.55	0.74	0.92	1.10	1.47

- E. Interior piping in vaults, buildings, etc. shall have zero leakage.
- F. Should leakage exceed this rate, the Contractor shall immediately locate the leak or leaks and repair them. Pipe will be accepted only when leakage is zero, or less than the allowable amount. Approval does not absolve the Contractor from responsibility if leaks develop later within the period of warranty.

3.10 DISINFECTION

- A. Before being placed in service, all new water pipe shall be chlorinated in accordance with ANSI/AWWA C651 Standard for Disinfecting Water Mains.
- B. The location of the chlorination and sampling points will be determined by the Engineer in the field. Taps for chlorination and sampling shall be installed by the Contractor. The Contractor shall uncover and backfill the taps as required.
- C. The pipe section being disinfected shall be flushed to remove discolored water and sediment from the pipe. A 25 mg/l chlorine solution in approved dosages shall be inserted through a tap at one end while water is being withdrawn at the other end of the pipe section. The chlorine concentration in the water in the pipe shall be maintained at a minimum 25 mg/l available chlorine during filling. To assure that this concentration is maintained, the chlorine residual shall be measured at regular intervals in accordance with procedures described in Standard Methods and AWWA M12, Simplified Procedure for Water Examination [Section K].
- D. During the application of the chlorine, valves shall be manipulated to prevent the treatment dosage from flowing back into the pipe supplying the water. Chlorine application shall not cease until the entire pipe section is filled with chlorine solution. The chlorinated water shall be retained in the pipe for at least a twenty-four hour period. The treated water shall contain a chlorine residual throughout the length of the pipe section as indicated in AWWA C651.

- E. Following the chlorination period, all treated water shall be flushed from the pipe section and replaced with water from the distribution system. Prior to disposal of treated water the Contractor shall check with local authorities to determine if the discharge will cause damage to the receiving body or sewer and, if required, the Contractor shall neutralize the chlorinated water in accordance with Appendix B, AWWA C650. Bacteriological sampling and analysis of the replacement water may then be made by the Contractor in full accordance with AWWA Specification C651. A minimum of three samples shall be taken by the Contractor at locations directed by the Engineer along the length of water pipe being chlorinated and sent to a State approved private laboratory for analyses. The Contractor shall re-chlorine if the samples show presence of coliform, and the pipe section shall not be placed in service until all of the repeat samples show no presence of coliform.
- F. Furnish two copies of a Certificate of Disinfection Report to the Engineer.
- G. The Contractor shall pay all costs for all testing, flushing, chlorinating; laboratory analyses, sampling, water supply and municipal charges.

END OF SECTION 33 1100

SECTION 33 31 00
SEWERAGE SYSTEM

PART 1 GENERAL

1.01 DESCRIPTION

- A. This Section specifies requirements for the sanitary sewerage system.

1.02 RELATED SECTIONS

- A. Sections which directly relate to the work of this Section include:
1. Section 31 2510 - Erosion and Sedimentation Control
 2. Section 31 0130 – Earthwork

1.03 SUBMITTALS

- A.
1. Materials list of materials proposed.
 2. Shop drawings for all material and structures prior to ordering materials.
- B. As-Built Drawings
1. Submit three (3) copies of As-Built Drawings upon completion and acceptance of work.
 2. As-Built Drawings shall be complete and shall indicate the true measurement and location, horizontal and vertical, of all new construction. As-Built Drawings shall include a minimum of three (3) ties to each manhole from fixed permanent objects. As-Built drawings shall also contain any additional information required by the municipality and shall be stamped with the seal of a Licensed Land Surveyor and Licensed Professional Engineer.

1.04 INSPECTION

- A. Materials:
1. The supplier is responsible for the provisions and all test requirements specified in ASTM D3034 for SDR 35 gravity pipe and ASTM D2241 for PVC pressure rated sewer pipe. In addition, all PVC pipe may be inspected at the plant for compliance with these specifications by an independent testing laboratory selected and paid by the Owner. The Contractor shall require the manufacturer's cooperation in these inspections.
 1. Inspection of the pipe may also be made after delivery. The pipe shall be subject to rejection at any time on account of failure to meet any of the specification requirements, even though pipe samples may have been accepted as satisfactory at the place of manufacture. Pipe rejected after delivery shall be marked for identification and shall be removed from the site at once.
 2. Imperfections in materials maybe repaired, subject to approval of the Engineer, after demonstration by the manufacturer that strong and permanent repairs result. Repairs shall be carefully inspected before final approval.
- B. Sewer Connection:
1. All connections to the municipal system shall be in strict accordance with the requirements of the Town of Wareham Sewer Department.
 2. File all applications for connections as required by the Sewer Department and pay all connection and application fees.

1.05 DELIVERY, STORAGE & HANDLING

- A. All materials shall be adequately protected from damage during transit. Pipes shall not be dropped.
- B. All pipe and other appurtenances shall be inspected before placement in the work and any found to be defective from any cause, including damage caused by handling, and determined by the Engineer to be un-repairable, shall be replaced at no cost to the Owner.
- C. Storage and handling of pipes, manholes and other sewer system appurtenances shall be in accordance with the manufacturer's recommendations, subject to the approval of the Engineer.

1.06 PERMITS BY THE CONTRACTOR

- A. The Contractor shall be required to obtain all necessary permits for proper execution of the Work. The Contractor shall fill out all forms and furnish all drawings required to obtain the permits, unless noted otherwise. Permits that maybe required for this project include, but is not limited to, the following:
 - 1. Local sewer connection permit.
 - 2. Excavation Permit

1.07 QUALIFICATIONS

- A. The utility contractor making the connection to the municipal sewer shall be a Licensed Drainlayer for the Town of Wareham. The Contractor shall coordinate with the Wareham Sewer Department prior to performing the work (see *Inspection* above).

1.08 WARRANTIES

- A. Provide manufacturer's written warranties for all materials. Sewer lift stations shall have a minimum manufacturer's 2-year warranty that guarantees its product to be free of defects in material and factory workmanship for the duration of the warranty period. Repair or parts replacement required as a result of such defect will be made free of charge during this period. Warranty shall at a minimum cover pump core assembly, basin, factory wiring and panel, including, but not limited to, grinder shredder ring, cutting impellers and monitoring devices against defects in workmanship and materials that may appear under normal and proper use.

PART 2 PRODUCTS

2.01 POLYVINYL CHLORIDE PIPE (PVC)

- A. Pipe and Fittings: Polyvinyl chloride pipe and fittings (4 inches to 15 inches) shall be Type PSM polyvinyl chloride (PVC) SDR 35 with full diameter dimensions conforming to the specifications for Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings, ASTM Designation D-3034.
- B. Joints: PVC pipe shall have an integral wall bell and spigot push-on joint with elastomeric gaskets secured in place in the bell of the pipe. The bell shall consist of an integral wall section with a solid cross section elastomeric gasket, factory assembled, securely locked in place to prevent displacement during assembly. Elastomeric gaskets shall conform to ASTM D3212.
- C. Connections to mains: Connections to sanitary sewer mains shall be made with a PVC wye fitting connection and Fernco-type couplings. The diameter of the main run of the wye connection shall match the diameter of the existing sewer main.

2.02 MANHOLES

A. Precast Units:

1. Structure: 4 foot minimum inside diameter precast units (4,000 psi minimum compressive strength) with eccentric cone section tapering to 24-inch diameter, or flat top, and one pour monolithic base section conforming to ASTM C478. All units shall be designed for HS-20 loading. Flat tops shall be used where manholes are less than 8 feet deep.
2. Precast Unit Joint Seals: Butyl rubber O-ring type seals conforming to ASTM C990.
3. The date of manufacture, trademark and name of the manufacturer shall be clearly marked on the inside of each precast section.
4. Manholes with an internal drop are to have a 5-foot internal diameter.

B. Masonry Units:

1. Brick shall conform to Sewer Brick (Made from Clay or Shale), ASTM designation C32, Grade MS or Building Brick (Solid Masonry Units Made from Clay or Shale), ASTM C62, Grade SW. Brick for construction of inverts and adjusting manholes to grade shall be Grade SM conforming to ASTM C32.
2. Concrete block shall be solid block and conforming to the Specifications for Concrete Masonry Units for Construction of Catch Basins and Manholes, ASTM designation C139.
3. Mortar shall be in conformance with ASTM C270, Type M. The mortar shall be composed of Portland cement hydrated lime, and sand, in the proportions of 1 part cement to 1/4 part hydrated lime to 3-1/2 parts sand, by volume.
4. Cement shall be Type I or II Portland cement conforming to ASTM C150, Standard Specification for Portland Cement. Where masonry is exposed to salt water, Type II shall be used.
5. Hydrated lime shall be Type S conforming to ASTM D207.
6. Sand for masonry mortar shall conform to the gradation requirements of ASTM C144.

C. Manhole Frame and Cover: Grey iron casting conforming to ASTM A48, heavy duty, with the word SEWER embossed on cover. Letter size shall be three inches. Frame and cover shall be LeBaron LA328-1 or approved equivalent.

D. Pipe Connections: Flexible sleeve or rubber gaskets shall be Lock Joint, Kor-n-Seal, A-Lok or approved equivalent.

E. Bitumastic Coating: The entire exterior surface of all manholes shall be coated with two coats of an approved bitumastic material to produce a dry film thickness of 0.07 inches (7 mils) per coat.

F. Steps: Steel reinforced copolymer polypropylene steps conforming to ASTM C478.

2.03 DUCTILE IRON PIPE

A. Ductile Iron Pipe: ASTM A746, extra heavy type, bell and spigot end.

B. Ductile Iron Pipe Joint: ANSI A21.11, rubber gasket joint.

2.04 INSULATION

A. Insulation: Insulation material to be a closed cell composition such as polystyrene. Open cell compositions with protective covers are not acceptable.

2.05 SEWER LIFT STATIONS

- A. The Town of Wareham Sewer Department requires the installation of sewer lift stations with grinder pumps at each building's sewer service prior to connection to the main.
- B. Sewer lift stations shall be appropriately sized, fully functional, pre-packaged sewer lift station with submersible grinder pumps. Only pre-packaged lift stations will be accepted.
- C. Lift station shall be Model WH484/WR484 multi-pump packaged lift station as manufactured by Environment One Corporation (eOne) Niskayuna, New York and distributed by F.R. Mahony & Associates, Inc., 273 Weymouth Street, Rockland, Massachusetts, (781) 982-9300 or Engineer approved equal.
- D. Lift station shall include controls and panel by the same manufacturer specifically intended for use with the model lift station.

PART 3 EXECUTION

3.01 EXCAVATION AND BACKFILLING

The type of materials to be used in bedding and backfilling and the method of placement shall conform to the requirements of Section 02210, Earthwork, and the details shown on the Drawings.

3.02 PIPE INSTALLATION

- A. All sewer pipe shall be laid accurately to the lines and grades shown in the Drawings and in conformance with pipe manufacturer's recommended procedures.
- B. Notch under pipe bells and joints, where applicable, to provide for uniform bearing under entire length of pipe.
- C. Laying Pipe: Each length of pipe shall be laid with firm, full and even bearing throughout its entire length, in a prepared trench. Pipe shall be laid with bells upgrade unless otherwise approved by the Engineer.

Every length of pipe shall be inspected and cleaned of all dirt and debris before being laid. The interior of the pipe and the jointing seal shall be free from sand, dirt and trash. Extreme care shall be taken to keep the bells of the pipe free from dirt and rocks so that joints may be properly lubricated and assembled. No pipe shall be trimmed or chipped to fit.

No length of pipe shall be laid until the proceeding lengths of pipe have been thoroughly embedded in place, to prevent movement or disturbance of the pipe alignment.
- D. Pipe Extension: Where an existing pipe is to be extended, the same type of pipe shall be used, unless otherwise approved by the Engineer.
- E. Full Lengths of Pipe: Only full lengths of pipe shall be used in the installation except that partial lengths of pipe with a maximum length of 5-feet shall be used at the entrance to structures, and to accommodate the required locations of service connection fittings.
- F. Pipe Entrances to Structures: All pipe entering structures shall be cut flush with the inside face of the structure, and the cut ends of the pipe surface within the structure shall be properly rounded and finished so that there will be no protrusion, ragged edges or imperfections that will impede or affect the hydraulic characteristics of the sewage flow. The method of cutting and finishing shall be subject to the approval of the Engineer.
- G. Protection During Construction: The Contractor shall protect the installation at all times during construction, and movement of construction equipment, vehicles and loads over and adjacent to any pipe shall be performed at the Contractor's risk.

At all times when pipe laying is not in progress, all open ends of pipes shall be closed by approved temporary water-tight plugs. If water is in the trench when work is resumed, the plug shall not be removed until the trench has been dewatered and all danger of water entering the pipe eliminated.

H. Water Pipe - Sewer Pipe Separation: When a sewer pipe crosses above or below a water pipe, the following procedures shall be utilized. The Contractor shall comply with these following procedures:

1. Relation to Water Mains

- a. *Horizontal Separation:* Whenever possible sewers shall be laid at a minimum at least 10 feet, horizontally, from any existing or proposed water main. Should local conditions prevent a lateral separation of 10 feet, a sewer may be laid closer than 10 feet to a water main if:
 - i. It is laid in a separate trench, or if
 - ii. It is laid in the same trench with the water mains located at one side on a bench of undistributed earth, and if
 - iii. In either case the elevation of the top (crown) of the sewer is at least 18 inches below the bottom (invert) of the water main.
- b. *Vertical Separation:* Whenever sewers must cross under water mains, the sewer shall be laid at such an elevation that the top of the sewer is at least 18 inches below the bottom of the water main. When the elevation of the sewer cannot be varied to meet the above requirements, the water main shall be relocated to provided this separation or reconstructed with mechanical-joint pipe for a distance of 10 feet on each side of the sewer. One full length of water main should be centered over the sewer so that both joints will be as far from the sewer as possible.

When it is impossible to obtain horizontal and/or vertical separation as stipulated above, both the water main and sewer shall be constructed of mechanical-joint cement lined ductile iron pipe or other equivalent based on watertightness and structural soundness. Both pipes shall be pressure tested by an approved method to assure watertightness or both pipes shall be encased in concrete.

3.03 PIPE JOINTS

- A. All joints shall be made water-tight.
- B. Pipe shall be jointed in strict accordance with the Pipe manufacturer's instruction. Jointing of all pipe shall be done entirely in the trench.
- C. PVC Pipe
 1. Lubricant for jointing of PVC pipe shall be applied as specified by the pipe manufacturer. Use only lubricant supplied by the pipe manufacturer.
 2. PVC Pipe shall be pushed home by hand or with the use of bar and block. The use of power equipment, such as a backhoe bucket, shall only be used at the direction of the manufacturer.
 3. Field-cut pipe ends shall be cut square and the pipe surface beveled to the size and shape of a factory-finished beveled end. All sharp edges shall be rounded off.
- D. Jointing of Ductile Iron and Cast Iron Pipe shall be in accordance with Section 33 1100, Water supply System.

3.04 MANHOLES

- A. General Requirements: All manholes shall be built in accordance with the Details and in the locations shown on the Drawings.
- Structures shall be constructed of brick masonry, precast solid concrete block, cast-in-place concrete or precast concrete.
- All masonry shall be installed by personnel experienced and skilled in this work, and any person not deemed to be such by the Engineer shall be removed and replaced by a person so qualified.
- Manholes shall be constructed as soon as the pipe laying reaches the location of the manhole. Should the Contractor continue pipe laying without making provision for completion of the manhole, the Engineer shall have the authority to stop the pipe laying operations until the manhole is completed.
- The Contractor shall accurately locate each manhole and set accurate templates to conform to the required line and grade. Any manhole which is mislocated or oriented improperly shall be removed and rebuilt in its proper location, alignment and orientation at no additional cost to the Owner.
- B. Foundations: All manholes shall be constructed on a 12-inch layer of compacted bedding material. The excavation shall be dewatered to provide a dry condition while placing bedding material and setting the base.
- C. Masonry: All brick or concrete block shall be thoroughly wetted before laying.
- The first course of masonry shall be embedded in the concrete foundation immediately after the foundation has been poured.
- All masonry shall be laid in full bed of mortar, and all vertical and horizontal joints shall be filled solid with mortar. Vertical joints on each succeeding course shall be staggered. Joints shall be not less than 3/8 inch or more than 1/2-inch wide. Joints on the inside of the structure shall be neatly struck and pointed.
- The exterior and interior surface of the walls shall be plastered with a one-half (1/2) inch coat of 1:2 cement mortar.
- D. Inverts: Brick invert channels shall be constructed in all manholes to provide a smooth channel for sewage flow through the structure, and shall correspond in shape to the lower half of the pipe. At changes in directions, the inverts shall be laid out in curves of the longest possible radii tangent to the centerline of the sewer pipes at the manhole side. Shelves shall be constructed to the elevation of the highest pipe crown and sloped to drain toward the flow channel.
- Special care shall be taken in laying brick inverts. Joints shall not exceed three-sixteenth inch in thickness and each brick shall be carefully laid in full cement mortar joints on bottom, side and end in one operation. No grouting or working in of mortar after laying of the brick will be permitted. Bricks forming the shaped inverts in manholes shall be laid on edge.
- Invert channels shall be built for future extensions where shown on the Drawings and where directed by the Engineer.
- E. Steps: Steps shall be installed in all manholes, spaced twelve inches on center vertically and set securely in place during the construction of the masonry wall.
- F. Precast Manholes: Precast manholes shall be installed only after Shop Drawings have been approved.
- The top grade of the precast concrete cone section shall be set sufficiently below finished grade to permit a maximum of five and a minimum of two courses of eight

inch brick to be used as risers to adjust the grade of the manhole frame. Manhole frames shall be set on a grout pad to make a water-tight fit.

3.05 CONNECTIONS TO EXISTING FACILITIES

- A. General Requirements: The Contractor shall make all required connections of the proposed sewer into existing sewer system, where and as shown on the Drawings and as required by the Engineer.
- C. Compliance with Requirements of Owner of Facility: Connections into existing sewer facilities shall be performed in accordance with the requirements of the Owner of the facility. The Contractor shall comply with all such requirements, including securing of all required permits, and paying the costs thereof. The costs of making the connections in accordance with the requirements of the owner of the existing facility shall be included in the Contract Sum and separate payment will be made.
- D. The contractor shall submit a bypass plan for approval to the Engineer that provides for sewer flows to be maintained at all times. This plan will include the provision of at least 3 pumps of equal capacity. The pumps will be sized to individually be capable of discharging the expected normal flow rate. The second pump is to provide additional flow capacity for peak flow conditions greater than normal. The third pump is a spare in case one of the primary pumps fail. These pumps will all be on site before the start of this work.

3.06 MANHOLE CONNECTIONS

- A. Manhole pipe connections for precast manhole bases may be accomplished by any method described below. The Contractor shall make sure that the outside diameter of the pipe is compatible with the particular pipe connection used.
 - 1. A tapered hole filled with non-shrink waterproof grout after the pipe is inserted. This connection method will not be allowed when connecting PVC pipe to manholes.
 - 2. The LOCK JOINT Flexible Manhole Sleeve cast in the wall of the manhole base. The stainless steel strap and exposed sleeve shall be protected from corrosion with a bitumastic coating.
 - 3. PRESS WEDGE II gasket cast into the wall on the manhole base. The rubber wedge shall only be driven into the V slot from the outside of the manhole.
 - 4. The RES-SEAL, a cast iron compression ring which compresses a rubber "O" ring gasket into a tapered hole in the wall of the manhole base. Exposed metal shall be protected from corrosion with a bitumastic coating.
 - 5. KOR-N-SEAL neoprene boot cast into the manhole wall. The stainless steel clamp shall be protected from corrosion with a bitumastic coating.
- B. Sewer manholes shall be constructed with drop connections when the proposed invert of the connection is at least 2 feet above the manhole invert. Drop connections for differences of less than 2 feet shall also be provided if required by the governing authority.

3.08 SERVICE CONNECTIONS

- A. General Requirements: The Contractor shall make all required connections of the building sewer service pipes into the sewer system. Work shall include making the service pipe connections into the sewer system pipes or into the manholes located ten (10) feet outside of the proposed building lines. If stubs are constructed for later connection to the building pipes, the ends shall be sealed with watertight plugs.
- B. Coordination with Building Contractor: The Contractor shall coordinate the work with the work of the Building Contractor to determine the exact location and elevation of the point of entry into the building.

- C. Connection into Sewer System: Sewer service pipe connections to the pipe of the sewer system shall be made with fittings supplied by the pipe manufacturer.

The Contractor shall install 45 degree wye branch or 90 degree tee fittings in the sewer pipes at all locations where building sewer service pipe connections are shown on the Drawings. Connections of the sewer service pipes shall be made into the wye branches or tees by means of 45 degree bends. The connections shall be made thoroughly watertight and concrete shall be placed under each connection to bear on undisturbed earth and firmly support the connection. Sewer chimneys shall be encased in concrete unless directed otherwise by the Engineer.

3.09 MINIMUM COVER

- A. In locations with less than 48-inches of cover over the sewer pipe, the pipe shall be insulated.
- B. For a depth of cover of 3-feet to 4-feet provide minimum of 2-inches of insulation.
- C. For a depth of cover of 2-feet to 3-feet provide minimum of 4-inches of insulation.

3.10 LEAKAGE TESTS

- A. General Requirements: The Contractor shall test the completed sewer system, including manholes and service connections, for leakage by infiltration, exfiltration, low-pressure air exfiltration or vacuum tests. The tests shall be conducted as approved by the Engineer. The Contractor shall furnish all necessary equipment, materials and labor for performing the tests.

The Contractor shall notify the Engineer at least 48 hours prior to the start of testing. Testing shall only be performed in the presence of the Engineer.

Sections of pipe tested for infiltration and exfiltration prior to completion of the Contract shall be subject to additional leakage tests, if warranted, in the opinion of the Engineer, prior to acceptance of the Work.

- B. Infiltration and Exfiltration Testing: The test length intervals for either type of leakage test shall be approved by the Engineer, but in no event shall they exceed one thousand feet. Where sewer pipe is laid on steep grades, the length to be tested by exfiltration at any one time shall be limited by the maximum allowable internal pressure on the pipe and joints at the lower end of the line. The maximum internal pressure at the lowest end shall not exceed 25 feet of water or 10.8 psi.

The test period, wherein the measurements are taken, shall not be less than four hours in either type of test.

Depending on field conditions, the following tests for leakage shall be employed:

1. Infiltration Test: The test may be used only when ground water levels are at least five feet above the top of the pipe for the entire length of the section to be tested during the entire period of the test. Ground water levels may be measured in an open trench or in standpipes previously placed in backfilled trenches during the backfilling operations. When standpipes are installed in the backfill for ground water measurement, the lower ends shall be satisfactorily embedded in a mass of crushed stone or gravel to maintain free percolation and drainage. Infiltration through joints shall be measured by using a watertight weir or any other approved device for volumetric measurement installed at the lower end of the section under test.
2. Exfiltration Test: This test consists of filling the pipe with water to provide a head of at least five feet above the top of the pipe or five feet above ground water, whichever is higher, at the highest point of the pipe section under test, and then measuring the loss of water from the line by the amount which must be added to maintain the original level. In this test, the pipe must remain filled

with water for at least twenty-four hours prior to the taking of measurements. Exfiltration shall be measured by the drop of water level in a closed-end standpipe or in one of the sewer manholes available for convenient measuring.

When a standpipe and plug arrangement is used in the upper manhole of a section under test, a positive method of releasing entrapped air in the sewer shall be installed prior to taking measurements.

3. Leakage Requirements: The total leakage of any section tested shall not exceed the rate of fifty (50) gallons per day per mile per inch of nominal pipe diameter. For purposes of determining the maximum allowable leakage, manholes shall be considered as sections of 48-inch diameter pipe, five feet long, and the equivalent leakage allowance shall be 2.25 gallons per manhole per 24 hours.

C. Low-Pressure Air Exfiltration Testing

1. The sewer pipes and service pipes shall be tested for leakage by the use of low-pressure air as approved by the Engineer. The test length shall not exceed one length of pipe between two manholes. Air test procedures may be dangerous and the Contractor shall take all necessary precautions to prevent blowouts.
2.
 - a. Pneumatic plugs shall have a sealing length equal to or greater than the diameter of the pipe to be tested.
 - b. Pneumatic plugs shall resist internal test pressures without requiring external bracing or blocking.
 - c. All air used shall pass through a single control panel.
 - d. Three individual hoses shall be used for the following connections:
 - From control panel to pneumatic plugs for inflation;
 - From control panel to sealed line for introducing the low pressure air;
 - From sealed line to control panel for continually monitoring the air pressure rise in the sealed line.
3. The following testing procedures shall be explicitly followed:
 - a. All pneumatic plugs shall be seal tested before being used in the actual test installation. One length of pipe shall be laid on the ground and sealed at both ends with the pneumatic plugs to be checked. Air shall be introduced into the plugs to 25 psig. The sealed pipe shall be pressurized to 5 psig. The plugs shall hold against this pressure without bracing and without movement of the plugs out of the pipe.
4. After the pipe has been backfilled and cleaned, pneumatic plugs shall be placed in the line at each manhole and inflated to 25 psi. Low-pressure air shall be introduced into this sealed line until the internal air pressure reaches 4 psi greater than the average back pressure of any ground water that may be over the pipe. At least two minutes shall be allowed for the air pressure to stabilize.

After the stabilization period (3.5 psi minimum pressure in the pipe), the portion of pipe tested shall be acceptable if the time required in minutes for the pressure to decrease from 3.5 to 3.0 psi (greater than the average back pressure of any ground water that may be over the pipe) is not less than the time indicated in the following table:

Pipe Size (in.)	Time (sec.)
4	0.190L
6	0.427L
8	0.760L
10	1.187L
12	1.709L
15	2.671L

Where L = length of pipe being tested

D. Vacuum Testing:

1. The sewer manholes shall be tested for leakage by the use of vacuum testing as approved by the Engineer. Vacuum test procedures may be dangerous and the Contractor shall take all necessary precautions to prevent blowouts.
2.
 - a. Pneumatic plugs shall have a sealing length equal to or greater than the diameter of the pipe to be tested.
 - b. Pneumatic plugs shall resist internal test pressures without requiring external bracing or blocking.
3.
 - a. The testing shall be done after assembly of the manhole.
 - b. The contractor shall plug the pipe openings.
 - c. With the vacuum tester set in place:
 - i. Inflate the compression band to 40 psi to effect a seal between the vacuum base and the structure.
 - ii. Connect the vacuum pump to the outlet port with the valve open.
 - iii. Draw a vacuum to 10-inches of mercury (10" Hg) and close the valve.
4. The test shall pass if the vacuum remains at 10" Hg. or does not drop to less than 9" Hg. within one minute. If the manhole fails the initial test, the contractor shall locate the leak and make proper repairs.

E. Correction of Defective Work: If leakage exceeds the specified amount, the Contractor shall make the necessary repairs or replacements required to permanently reduce the leakage to within the specified limit, and the tests shall be repeated until the leakage requirement is met.

F. Compliance with Agency Requirements: In the event of conflict between the leakage test requirements specified herein with the leakage test requirements of agencies having jurisdiction over all or any portion of the sewer system installed under this Contract, the more restrictive requirements shall govern.

3.11 DEFLECTION TESTING

A. Allowable Deflection Test (All PVC pipe between manholes shall be tested):

1. Pipe deflection measured not less than ninety days (90) after the backfill has been completed as specified shall not exceed five (5.0) percent. Deflection shall be computed by multiplying the amount of deflection (nominal diameter less minimum diameter when measured) by 100 and dividing by the nominal diameter of the pipe.
2. Deflection shall be measured with a rigid mandrel (Go/No-Go) device cylindrical in shape and constructed with a minimum of nine or ten evenly

spaced arms or prongs. Drawings of the mandrel with complete dimensions shall be submitted to the Engineer for each diameter of pipe to be tested. The mandrel shall be hand pulled by the Contractor through all sewer lines.

3. Any section of sewer not passing the mandrel shall be uncovered at the Contractor's expense and the bedding and backfill replaced to prevent excessive deflection. Repaired pipe shall be retested

3.12 SEWER LIFT STATION

- A. The prepackaged sewer lift stations shall be installed in strict accordance with the manufacturer's written instructions.

3.13 CLEANING AND REPAIR

- A. The Contractor shall clean the entire sewer system of all debris and obstructions. This shall include, removal of all formwork from structures, concrete and mortar droppings, construction debris and dirt. The system shall be thoroughly flushed clean and the Contractor shall furnish all necessary hose, pumps, pipe and other equipment that may be required for this purpose. No debris shall be flushed into existing sewers, storm drains and or streams.

All work of cleaning and repair shall be performed at no additional cost to the Owner.

3.14 FINAL INSPECTION

- A. Upon completion of the work, and before final acceptance by the Engineer, the entire sewer system shall be subjected to a final inspection in the presence of the Engineer. The work shall not be considered as complete until all requirements for line, grade, cleanliness, leakage tests and other requirements have been met.

END OF SECTION 33 3100

SECTION 33 4000
STORM DRAINAGE SYSTEM

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Installation of new storm drain pipe, manholes and catch basins.
 - 2. Relocation and/or replacement of existing storm drain pipe and catch basins.
 - 3. Installation of stormwater treatment units.
- B. Contractor shall coordinate work between all Contractors, sections, and trades required for the proper completion of the work.
- C. Contractor is responsible for all health and safety.
- D. Contractor is solely responsible for obtaining permits or approvals which may be required to perform the work of this section, including all costs, fees and taxes required or levied. Notify and obtain such permits or approvals from all agencies having jurisdiction prior to starting work.

1.2 REFERENCE STANDARDS

- A. Reference herein to any technical society, organization, group or regulation are made in accordance with the following abbreviations and, unless otherwise noted or specified, all work under this Section shall conform to the latest edition as applicable.
- B. Code of Federal Regulations (CFR)
 - 1. 29 CFR 1926, Safety and Health Regulations for Construction.
- C. American Society for Testing and Materials (ASTM)
 - 1. ASTM A36 - Standard Specification for Carbon Structural Steel.
 - 2. ASTM A48 - Standard Specification for Gray Iron Castings.
 - 3. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 4. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
 - 5. ASTM A536 - Standard Specification for Ductile Iron Castings.
 - 6. ASTM A615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
 - 7. ASTM C55 - Standard Specification for Concrete Building Brick.
 - 8. ASTM C76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
 - 9. ASTM C 94 - Standard Specification for Ready-Mixed Concrete.
 - 10. ASTM C139 - Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes.
 - 11. ASTM C150 - Standard Specification for Portland Cement.
 - 12. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes.
 - 13. ASTM C270 - Standard Specification for Mortar for Unit Masonry.
 - 14. ASTM C387 - Standard Specification for Packaged, Dry, Combined Materials for Mortar and Concrete.

15. ASTM C443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
 16. ASTM C443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
 17. ASTM C478 - Standard Specification for Precast Reinforced Concrete Manhole Sections.
 18. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
 19. ASTM C877 - Standard Specification for External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections.
 20. ASTM C923 - Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals.
 21. ASTM C990 - Standard Specification for Joints for Concrete Pipe, Manholes and Precast Box Sections Using Preformed Flexible Joint Sealants.
 22. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
 23. ASTM D2412 - Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.
 24. ASTM D3212 - Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
 25. ASTM D3350 - Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.
 26. ASTM F402 - Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings.
 27. ASTM F405 - Corrugated Polyethylene (PE) Tubing and Fittings.
 28. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
 29. ASTM F714 - Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.
 30. ASTM F894 - Standard Specification for Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe.
 31. ASTM F2306 - Standard Specification for 12 to 60 inch [300 to 1500 mm] Annular Corrugated Profile-Wall Polyethylene (PE) Pipe and Fittings for Gravity-Flow Storm Sewer and Subsurface Drainage Applications.
 32. ASTM F2648 - Standard Specification for 2 to 60 inch [50 to 1500 mm] Annular Corrugated Profile Wall Polyethylene (PE) Pipe and Fittings for Land Drainage Applications.
- D. American Concrete Pipe Association (ACPA).
1. ACPA 01-103 - Concrete Pipe and Box Culvert Installation (latest revision and applicable supplements thereto).
- E. American Association of State High and Transportation Officials (AASHTO).
1. AASHTO H20 - Standard Specifications for HS-20, Highway Loading.
 2. AASHTO M105 - Standard Specification for Gray Iron Castings.
 3. AASHTO M252 - Standard Specification for Corrugated Polyethylene Drainage Pipe.
 4. AASHTO M294 - Standard Specification for Corrugated Polyethylene Pipe, 300- to 1500-mm Diameter.

- F. Corrugated Polyethylene Pipe Association (CPPA).
 - 1. Recommended Installation Practices for Corrugated Polyethylene Pipe and Fittings (latest revision and applicable supplements thereto).
- G. State of Massachusetts Highway Department (MHD)
 - 1. Standard Specifications for Highways and Bridges, latest edition, and any supplements.

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. Submit shop drawings, descriptive literature, or both, showing pipe materials and appurtenances to be furnished. Shop Drawings shall be submitted to Engineer for approval prior to ordering materials.
 - 2. Shop drawings showing the configuration, dimensions, layout, and spacing of major and minor components such as pipe, joints, couplings, restraints, and other proposed details of assembly. Show in large-scale details any unique assembly, pipe/pipe transitions, pipe/structure transitions, and/or installation requirements.
- B. Copies of manufacturer-provided installation instructions, operation instructions, and maintenance material for all equipment furnished under this Section.
- C. Manufacturer's warranties and associated warranty registration data in Owner's name. Submit two (2) copies of each warranty to Engineer in the manufacture/supplier standard form or if there is no standard form available, in a form specified by Engineer.
- D. As-Built Drawings.

1.4 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workmen who are trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and methods required for proper performance of the work in this Section. Use equipment of adequate size, capacity and quantity to accomplish the work of this Section in a timely manner.
- B. Codes and Standards: Perform earthwork complying with requirements of authorities having jurisdiction.
- C. Sample pipe for testing, when requested by Engineer, shall be furnished by Contractor in sufficient numbers. The Contractor and/or the pipe manufacturer shall make the facilities and services for making the load tests available.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Delivery and Storage
 - 1. Manufacturer shall package the pipe and other drainage materials in a manner designed to deliver the pipe to the Project Site neatly, intact, and without physical damage. Transportation carrier shall use an appropriate method to ensure the pipe is properly supported, stacked, and restrained during transport. Inspect materials delivered to site for damage; store with minimum of handling.
 - 2. Unloading of the pipe and other drainage materials should be controlled so as not to collide with the other pipe sections or fittings, and care should be taken to avoid chipping or spalling, especially to the spigots and bells. For manhole sections, cone sections, bases, fittings and other precast appurtenances, utilize lifting holes or lifting eyes provided.
 - 3. In cold weather conditions, use caution to prevent impact damage. Handling methods considered acceptable for warm weather may be unacceptable during cold weather.

4. Storage:
 - a. Store materials on site in enclosures or under protective coverings. Do not store materials directly on the ground. Keep inside of pipes and fittings free of dirt and debris.
 - b. Pipe shall be stored on clean, level ground to prevent undue scratching or gouging.
 - c. Store solvents, solvent compounds, lubricants, elastomeric gaskets, and any similar materials under cover out of direct sunlight. Provide additional storage measures in accordance with the manufacturer's recommendations. Discard materials if storage period exceeds the recommended shelf life. Solvents in use shall be discarded when the recommended pot life is exceeded.
 - d. Metal Items: Check upon arrival; identify and segregate as to types, functions, and sizes. Store off the ground in a manner affording easy accessibility and not causing excessive rusting or coating with grease or other objectionable materials.
 - e. Cement, Aggregate, and Reinforcement: As specified in Section 033200 – Site Cast-in-Place Concrete.
 - f. Store manhole units in an upright position.

PART 2 MATERIALS

2.1 GENERAL

- A. Products furnished under this Section which are damaged or found defective in any way prior to being set in place and final acceptance, may be rejected. Engineer may reject an entire lot of pipe should the sample pipe from such lot fail to meet requirements.

2.2 CORRUGATED POLYETHYLENE PIPE

- A. Pipe: High density polyethylene, corrugated, smooth interior, ASTM D3350, Cell Classification 424420C.
 1. Four (4) inch through 10-inch diameter pipe: AASHTO M252, Type S.
 2. 12 inch through 60 inch diameter pipe: AASHTO M294, Type S or ASTM F2306.
- B. Joints: Bell-and-spigot joint, AASHTO M252, AASHTO M294, or ASTM F2306. Bell shall be an integral part of the pipe and provide a minimum pull-apart strength of 400 pounds. Bell-and-spigot joint shall incorporate a gasket making it silt-tight. Gaskets shall be installed in the bell, or on the pipe by the pipe manufacturer.
 1. Four-inch (4") through 60-inch (60") diameter pipe joint, watertight, ASTM D3212. Gaskets: polyisoprene, ASTM F477. Gaskets shall be installed by the pipe manufacturer and covered with a removable, protective wrap to ensure the gasket is free from debris. A joint lubricant available from the manufacturer shall be used on the gasket and bell during assembly.
 2. 12-inch (12") through 60-inch (60") diameter pipe shall have a reinforced bell with a bell tolerance device. The bell tolerance device shall be installed by the manufacturer.
 3. Coupling bands shall conform to the manufacturer's specifications. Couplers shall cover not less than one corrugation on each section of pipe.
- C. Fittings: AASHTO M252, AASHTO M294, or ASTM F2306. Bell and spigot connections shall utilize a spun-on or welded bell and valley or saddle gasket meeting the watertight joint performance requirements of AASHTO M252, AASHTO M294 or ASTM F2306.
- D. Saddle Tee
 1. Saddle tees shall be manufactured saddle tees designed to connect to the corrugated polyethylene pipe.

2. Fittings shall conform to AASHTO M 294. Fabricated fittings shall be welded on the interior and exterior of all junctions.
3. A soil-tight seal shall be obtained with the coupling at the saddle tee stub to the storm service pipe.

2.3 JOINT LUBRICANT

- A. As specified by pipe manufacturer, ANSI/AWWA C111/A21.11.

2.4 CATCH BASINS

- A. Reinforced precast concrete base, sump, transition, riser, corbel, and top: ASTM C913 for precast rectangular catch basins, ASTM C478 for precast circular catch basins. Type and dimensions as indicated on the Drawings.
 1. Concrete: 4,000 psi minimum, 4% - 7% entrained air.
 2. Reinforcement: ASTM C890. Steel bars, ASTM A615. Welded-wire fabric, ASTM A185. Additional reinforcing at openings.
 3. Precast sections shall consist of smooth sections in standard nominal inside diameters. All precast concrete sections shall be free from cracks, damaged joints, exposed reinforcing, aggregate pockets, spalls, and dimensional distortions or other irregularities. Lifting holes shall be filled with mortar, or other approved material.
 4. Openings or "knockouts" in precast units shall be located as shown on the Drawings and to accommodate the inflow and outflow pipe orientation required. Openings shall be sized sufficiently to permit passage of the largest outside dimension of pipe or fittings. Prior to ordering precast manhole bases, all angles between incoming pipes are to be field checked to incorporate possible line changes required in the field layout.
 5. External damp-proofing: Asphalt, ASTM D449, Type A.
- B. Gaskets for joints between sections: Butyl rubber, ASTM C 443.
- C. Grade Rings: ASTM C 478, precast reinforced concrete, 1 inch to 4-inch thickness, dimensions to match basin and top section.
- D. Catch basin trap
 1. Cast Iron LeBaron Oil and Grease Trap Model L-219, Neenah Catch Basin Trap R-3700, or approved equivalent.
- E. Frame and Grate.
 1. Cast iron: AASHTO M 105, Class 25 for frames and Class 30 for grates.

2.5 CONCRETE MANHOLE

- A. Precast concrete manhole risers, base sections, and tops: ASTM C 478. Precast manhole sections shall consist of smooth circular sections in standard nominal inside diameters. All precast concrete manhole sections shall be free from cracks, damaged joints, exposed reinforcing, aggregate pockets, spalls, and dimensional distortions or other irregularities. Lifting holes, when provided, shall be filled with mortar, or other approved material.
 1. Concrete: 4,000 psi minimum, 4% - 7% entrained air.
 2. Diameter: 48-inches unless otherwise indicated.
 3. Base and first riser: Monolithic and built to the dimensions and requirements indicated on the Drawings.
 - a. Bottoms shall be integrally cast unless specialty bases ("Dog-House") at points of connection to existing piping is indicated on the Drawings or otherwise proposed for use. Unless indicated on the Drawings, any special bases or riser used must be detailed in shop drawings and submitted for approval.
 4. Riser sections: As required to provide depths indicated.

5. Top Section: Concentric-cone type, unless eccentric-cone or flat-slab-top type is indicated. Cones shall have the same wall thickness and reinforcement as riser sections. If required or called-for, flat slab shall be a minimum of 8-inches thick designed to carry AASHTO H-20 loading with one foot cover and conform to ASTM C478.
 6. External damp-proofing: Asphalt, ASTM D449, Type A.
 7. Internal waterproofing: Where required, 60-mil polyvinylchloride or polyethylene sheet with webs or ribs to mechanically lock the sheet to the manhole wall. Joint strips shall be ribless and shall be a minimum of 4 inches wide.
 8. Openings or "knockouts" in precast units shall be located as shown on the Drawings and to accommodate the inflow and outflow pipe orientation required. Openings shall be sized sufficiently to permit passage of the largest outside dimension of pipe or fittings. Prior to ordering precast manhole bases, all angles between incoming pipes are to be field checked to incorporate possible line changes required in the field layout.
- B. Gaskets for joints between manhole sections: Butyl rubber, ASTM C 443.
- C. Grade Rings: ASTM C 478, precast reinforced concrete, 1 inch to 4-inch thickness, diameter to match manhole and frame.
- D. Mortar: Packaged, ASTM C 387 or as Specified in Section 033200 – Site Cast-in-Place Concrete.
- E. Frame and Cover: Grey Cast Iron, ASTM A48, Class 25B (Frame) and Class 30B (Covers), uncoated.
1. Cover: 26-inch diameter, non-vented with non-penetrating pickholes. Unless otherwise detailed or indicated, covers shall be cast with 1-1/2-inch-wide, raised letters, indicating "STORM SEWER" unless other lettering is called-for.
 2. Frame and cover shall be supplied as a pair from the same manufacturer. Castings shall be of tough, even-grained iron, free from scale, lumps, blisters, sand-holes and other injurious defects, and of the size and type shown on the drawings. Frames and covers shall have machined bearing surfaces to seat firmly and prevent rocking and rattling under traffic loads. Before leaving the foundry, castings shall be thoroughly cleaned, subjected to hammer tests for soundness and given two coats of coal tar pitch varnish.
- F. Resilient connectors for joints between manhole and pipes entering manhole: Continuous boot of 3/8 inch minimum thickness neoprene, ASTM C 923 or ASTM C 990. Boots shall be either cast into the manhole wall or installed into a cored opening using internal compression rings. Installed boot shall result in a water-tight connection meeting the performance requirements of ASTM C 443.
- G. Manhole Steps: ASTM C 478 and OSHA 29 CFR 1910.27, drop front or equivalent. Steps shall be nine inches in depth and at least twelve inches in width with an abrasive step surface.
1. Composite Plastic-Steel: One-half (1/2) inch deformed steel reinforcing rod, ASTM A615, Grade 60, encapsulated in a co-polymer polypropylene plastic, ASTM D2146, Type II, Grade 16906.
 2. Steps shall be placed in vertical alignment as indicated on the Drawings. Steps shall be uniformly spaced not more than sixteen inches (16") on center, including the spacing between the top step and the manhole cover. Steps shall be embedded in the wall a minimum distance of 4 inches in either cast or drilled holes. Steps shall not be driven or vibrated into fresh concrete and shall withstand a pullout resistance of 2000 lbs when tested in accordance with ASTM C 497. Each step shall project a minimum of 5 inches from the wall measured from the point of embedment.

2.6 MASONRY UNITS

- A. Brick: ASTM C32 Grade MS or ASTM C62 Grade SW.
- B. Concrete block: Solid block, ASTM C139.

2.7 MORTAR

- A. Mortar: ASTM C 387.
 - 1. Portland Cement: ASTM C 150, Type I.
 - 2. Sand: ASTM C 144.
 - 3. Hydrated Lime: ASTM C 207.
 - 4. Water: Potable.
 - 5. Mix proportions for manhole rims and covers: 1 part portland cement, 2 parts sand, and 1/4 part hydrated lime by dry volume. Hydrated lime shall not exceed 10 percent by weight of the total dry mix. Quantity of water in mixture shall be sufficient to produce a stiff, workable mortar, but in no case shall exceed 5-1/2 gallons of water per sack of cement.
 - 6. Mix Proportions for invert construction: 1 part portland cement and 2 parts sand by volume. Quantity of water in mixture shall be sufficient to produce a stiff, workable mortar, but in no case shall exceed 5-1/2 gallons of water per sack of cement.

2.8 BEDDING

- A. Bedding for pipes: Unless otherwise directed by Engineer, bedding shall consist of screened gravel, maximum size 3/4 inches and minimum size 3/8 inches.
- B. Bedding for Catch Basins: Screened Gravel or Crushed Stone, well graded in size from 3/4 inch to 3/8 inch consisting of clean, hard, and durable fragments. No limestone shall be permitted.

2.9 UNDERGROUND INFILTRATION CHAMBERS

- A. Underground infiltration chambers shall be MC-3500 and MC-4500 chambers as manufactured by StormTech, an ADS Company (<https://www.stormtech.com/>) or Engineer approved equal.
- B. Alternate underground infiltration chambers shall only be considered "equal" if capable of providing the equivalent stormwater storage volume within the same horizontal and vertical footprint. Alternate chambers shall be capable of providing equivalent pipe inlets and outlets that result in no-increase to peak discharge rates from each chamber system for the 2, 10, and 100-year, 24-hour design storm. The design information can be provided for use upon written request to the Engineer. The burden of proof of equality of product shall be on the Contractor. The Engineer shall not perform new calculations to verify equality.

PART 3 EXECUTION

3.1 PIPE INSTALLATION

- A. As soon as the excavation is completed to the normal grade of the bottom of the trench, the Contractor shall immediately place the bedding material in the trench. Then the pipe shall be firmly bedded in the compacted bedding material to conform accurately to the lines and grade indicated on the Drawings.
- B. Install pipe, fittings, and accessories in accordance with manufacturer's instructions.
- C. Notch under pipe bells and joints, where applicable to provide for uniform bearing under entire length of pipe.
- D. Excavation, backfilling and compaction shall be as specified in Section 312310 - Earthwork of these Specifications.
- E. Maintain optimum moisture content of bedding material to attain required compaction density.

3.2 MANHOLES AND CATCH BASINS

- A. Manholes and Catch Basins shall be constructed at the locations and to the lines, grades and dimensions noted on the Drawings, or as required.
- B. Precast concrete construction shall be done in a manner to insure watertight construction and all leaks in precast concrete shall be sealed. If required, precast concrete shall be repaired or replaced to obtain watertight construction.
- C. Concrete barrels and cones shall be precast concrete sections.
 - 1. Bases shall be either precast with a barrel integrally cast with the base, or poured concrete suitably shaped by means of accurate bell-rung forms to receive the barrel sections. Manhole invert channels in manholes shall be formed in concrete.
 - 2. Precast manholes shall have an adjustment ring at the top of the cone to permit the frame and cover to meet the finished surface. This shall consist of courses of brick or reinforced grading rings not to exceed 11 inches.
- D. Stubs shall be short pieces cut from the bell ends of the appropriate size and class of pipe. Concrete stubs shall be plugged with brick masonry unless otherwise directed.
- E. Manhole inverts - shall conform accurately to the size of the adjoining pipes.
 - 1. Manhole inverts shall be constructed of concrete developing 3,500 psi with the concrete being placed to the spring line of the pipe form.
 - 2. Smooth plastic pipe, matching the dimension of the outlet pipe, shall be used to form the invert.
 - 3. Side inverts and main inverts, where the direction changes, shall be laid out in smooth curves of the longest possible radius, which is tangent, within the manhole, to the centerline of adjoining pipelines.
 - 4. Invert shelves shall be graded to provide a 1-inch per 1-foot wash from the manhole walls.
- F. Manhole sections shall contain manhole steps accurately positioned and embedded in the concrete when the section is cast. Precast-reinforced concrete manhole sections shall be set so as to be vertical and with sections and steps in true alignment.
- G. All holes in sections used for their handling shall be thoroughly plugged with rubber plugs, made specifically for this purpose, or with mortar. The mortar shall be one part cement to 1-1/2 parts sand, mixed slightly damp to the touch (just short of "balling"), hammered into the holes until it is dense and an excess of paste appears on the surface, and then finished smooth and flush with the adjoining surfaces.
- H. The Contractor may, as an alternate to suitable nonshrink mortar joints, use premolded elastomeric-sealed joints for pipe into precast manhole bases.
 - 1. All materials, accessories and construction methods used in making the joints shall be supplied or approved by the manufacturer of the premolded elastomeric-sealed joint.
- I. Openings for pipe and materials to be embedded in the walls of the base for these joints shall be cast in the base at the required locations during the manufacture of the base. Incorrectly cast and patched pipe openings will be rejected.
- J. Manhole risers and tops shall be installed using approved "o-ring" type, neoprene gaskets for sealing joints. Units shall be installed level and plumb. Water shall not be permitted to rise over newly made joints nor until after inspection as to their acceptability. All jointing shall be done in a manner to insure water tightness.
- K. Openings shall be provided in the risers to receive entering pipes. These openings may be made at the place of manufacture. The openings shall be sized to provide a uniform 1 inch maximum annular space between the outside of the pipe wall and the opening in the riser. After the pipe is in position, the annular space shall be solidly filled with nonshrink mortar.

Care shall be taken to assure that the openings are located to permit setting of the entering pipe at its correct elevation as indicated.

- L. Openings, which are cut in the risers in the field, shall be carefully made by coring so as not to damage the riser. Damaged risers will be rejected and shall be replaced at no additional expense to the Owner.
- M. Where required by the Drawings, a slot and opening shall be cast in the catch basin wall suitable for mounting the cast iron hood and discharge pipe. The hood hinge may be furnished to the precast supplier by the Contractor for incorporation into the casting during manufacture.

3.3 BRICK MASONRY

- A. Brick Masonry Construction shall be done in a manner to insure watertight construction and all leaks in brick masonry shall be sealed. All workmanship shall conform to the best standard practice and all brick masonry shall be laid by skilled workmen.
- B. All beds on which masonry is to be laid shall be cleaned and wetted properly. Brick shall be wetted as required and shall be damp but free of any surface water when placed in the Work. Bed joints shall be formed of a thick layer of mortar, which shall be smoothed or furrowed slightly. Head joints shall be formed by applying to the brick to be laid a full coat of mortar on the entire end, or on the entire side as the case requires, and then shoving the mortar covered end or side of the brick tightly against the bricks laid previously. The practice of buttering at the corners of the brick and then throwing the mortar or crappings in the empty joints will not be permitted. Dry or butt joints will not be permitted. Joints shall be uniform in thickness and shall be approximately 1-1/4 inch thick.
- C. Brickwork shall be constructed accurately to dimensions and brickwork at top of manholes shall be to the dimensions of the flanges of the cast-iron frames.
- D. Joints on the inside face of walls shall be tooled slightly concave with an approved jointer when the mortar is thumbprint hard. The mortar shall be compressed with complete contact along the edges to seal the surface of the joints.
- E. All castings to be embedded in the brickwork shall be accurately set and built-in as the Work progresses. Cast-iron frames and manhole covers shall be well bedded in mortar and accurately set to finished graded indicated or as directed.
- F. Water shall not be allowed to flow against brickwork or to rise on the masonry for 60 hours after it has been laid, and any brick masonry damaged in this manner shall be replaced as directed at no additional expense to the Owner. Adequate precautions shall be taken in freezing weather to protect the masonry from damage by frost.

3.4 CONCRETE MASONRY UNITS

- A. Concrete Masonry unit construction shall be soaked in water before laying. As circular concrete block walls are laid-up, the horizontal joints and keyways shall be flushed full with mortar. As rectangular blocks are laid-up, all horizontal and vertical joints shall be flushed full with mortar. Plastering of the outside of block structures will not be required. The joints in precast units shall be wetted and completely mortared immediately prior to setting a section. No structure shall be backfilled until all mortar has completely set.

3.5 MANHOLE STEPS

- A. Placement of steps into the precast walls shall be by a proven method as recommended by the supplier of the precast manhole sections. Details of the steps and method of placement shall be submitted for approval.
- B. Plastic steps shall be placed into the wet concrete wall during manufacture or if designed for press fit installation shall be driven into a wall opening according to the manufacturer's specifications. Steps shall not be mortared into place after the concrete has set.
- C. All manholes, catch basins, lawn inlets, etc., which are in excess of five feet in depth, shall be constructed with standard aluminum steps, spaced at 12-inch on center.

3.6 CASTINGS

- A. Cast-iron frames for grates and covers shall be well bedded in cement mortar and accurately set to the grades indicated or as directed. The frames shall be encased with a thick cement-mortar collar around the entire perimeter of the frames.
- B. All voids between the bottom flange shall be completely filled to make a watertight fit. A ring of mortar, at least one-inch thick and pitched to shed water away from the frame shall be placed over and around the outside of the bottom flange. The mortar shall extend to the outer edge of the masonry all around its circumference and shall be finished smooth. No visible leakage will be permitted.
- C. Structures within the limits of bituminous concrete pavement shall be temporarily set at the elevation of the bottom of the binder course or as ordered. After the binder course has been compacted, these structures shall be set at their final grade. Backfill necessary around such structures after the binder course has been completed shall be made with Class A concrete unless otherwise ordered.

3.7 UNDERGROUND INFILTRATION SYSTEMS

- A. Underground infiltration systems shall be installed in strict accordance with the manufacturer's written instructions.

3.8 CLEANING

- A. At the completion of the Work, clean all piping, structures and open drainage courses, through and to which water from this construction is directed, to the satisfaction of Engineer.

3.9 AS-BUILT DRAWINGS

- A. Contractor shall be solely responsible for complying with the requirements of local permitting authorities for preparation and submittal of as-built drawings. The requirements for the preparation of as-built drawings as defined herein shall be considered the minimum requirements of Engineer, but shall in no way relive Contractor from satisfying the requirements of local permitting authorities.
- B. As work progresses, record the following on two (2) sets of Drawings:
 - 1. All changes and deviations from the design in location, grade, size, material, or other feature as appropriate.
 - 2. Any uncharted locations of utilities or other subsurface feature encountered during installation, including the characteristics of such uncharted utility or subsurface feature such as utility type, size, depth, material of construction, etc.
- C. Recording of changes shall be clearly and neatly marked in red pen or pencil. All changes shall be noted on the appropriate Drawing sheets.
- D. Make measurements from fixed, permanent points on the Project Site to accurately locate the work completed. Such measurements shall consist of at least three (3) ties showing the distance of each item relative to each of the fixed, permanent points.
- E. As-Built Drawings shall be complete and shall indicate the true measurement and location, horizontal and vertical, of all new construction. As-Built drawings shall also contain any additional information required by Engineer.

END OF SECTION 33 4000