

**City of New Braunfels Fire Training Site Infrastructure
353 FM 306
New Braunfels, Texas 78130**

PROJECT MANUAL

November 1, 2022
BRW PROJECT NO. 219065.00

THE CITY OF NEW BRAUNFELS

550 LANDA STREET
NEW BRAUNFELS, TX, 78130
(830) 221-4000

OWNER

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STRUCTURAL / CIVIL ENGINEER

DAWSON VAN ORDEN ENGINEERING

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(281) 293-7500

**MECHANICAL / ELECTRICAL /
PLUMBING ENGINEER**

SECTION 00 00 07 - SEALS PAGE

ARCHITECT AND CONSULTANT'S SEALS PAGE

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979 / 694-1791



11/01/2022

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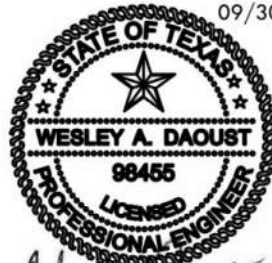


11/11/22

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09/30/22

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PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 GEOTECHNICAL INVESTIGATION

- A. A Geotechnical Investigation for the project site has been performed by Gessner Engineering, 2501 Ashford Drive, College Station, TX 77840. A copy of Gessner's Report, Job No. 20-0404, dated September 30, 2020, is bound herein.
- B. Log of borings indicates materials penetrated at specific locations. Owner and/or Architect assume no responsibility for any conclusions of interpretations made by Contractor related to information included in the Report. Should contractor require additional information concerning subsurface conditions, he may without cost to Owner, make additional investigations. Should additional investigations produce information different from that in Soil Report, promptly notify Owner in writing.
- C. Contractor shall read and otherwise become completely familiar with contents of Soil Report, including but not limited to its recommendations for preparation of subsoil, bases, sub-bases and fill and construction of building foundations and parking surfaces in compliance with recommendations in Report. Should discrepancy be found between the requirements of Soil Report and the drawings and/or specifications, notify Owner in writing prior to beginning work.

1.03 EXISTING CONDITIONS

- A. Bidders shall visit the site of work, existing buildings, review any available existing drawings, and all conditions affecting the work of this project. Any claims after contract award for difficulties encountered which could have been foreseen by such site review will not be recognized by the Owner.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

Not used.

END OF SECTION 00 30 00

Mr. Ray Holliday

Brown Reynolds Watford Architects
175 Century Square Drive, Suite 350

College Station, Texas 77840

September 30, 2020



GESSNER
ENGINEERING

GEOTECHNICAL ENGINEERING STUDY

New Braunfels Fire Station No. 7

355 Farm to Market Road 306

New Braunfels, Texas

Gessner Engineering Job No. 20-0404

September 30, 2020

Mr. Ray Holliday
Brown Reynolds Watford Architects
175 Century Square Drive, Suite 350
College Station, Texas 77840



Re: Geotechnical Engineering Study
New Braunfels Fire Station No. 7
355 Farm to Market Road 306
New Braunfels, Texas
Gessner Engineering Job No. 20-0404

Dear Mr. Holliday:

This report conveys our geotechnical engineering study conducted for the proposed New Braunfels Fire Station No. 7 to be located in New Braunfels, Texas. The following report contains our design recommendations and considerations based on our understanding of the information provided to us. The purpose of this study was to drill borings within each proposed building footprint and pavement area, to perform laboratory testing to classify and characterize subsurface conditions, and to prepare an engineering report presenting foundation design and construction recommendations for the proposed structures, as well as pavement design and construction recommendations. We trust that this report is responsive to your project needs. Please contact us if you have any questions or if we can be of further assistance.

We are happy to be of service to you on this phase of the project and look forward to the opportunity to provide additional services for geotechnical engineering, structural engineering, civil engineering, land surveying, and construction materials testing as the project progresses.

Sincerely,
GESSNER ENGINEERING, LLC F-7451

A handwritten signature in blue ink that reads 'Prashant M. Patil'.

Prashant M. Patil, E.I.T.

A handwritten signature in black ink that reads 'Michael C. Fucinari'.

Michael C. Fucinari, P.E.

Copies Submitted:
Mr. Ray Holliday

September 30, 2020



COLLEGE STATION • BRENHAM • FORT WORTH • GEORGETOWN • SAN ANTONIO

Corporate: 2501 Ashford Drive / College Station, Texas 77840 • 1-877-GESSNER • www.gessnerengineering.com

CIVIL CONSTRUCTION MATERIALS TESTING GEOTECHNICAL STRUCTURAL SURVEYING

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Introduction

This report describes the procedures utilized during this study and presents the results of our geotechnical engineering investigation for the proposed New Braunfels Fire Station No. 7. Gessner Engineering was authorized to provide the subsurface investigation and report for this project by Mr. Ray Holliday on June 1, 2020.

Project Description

The project consists of the proposed construction of a fire station, training classroom, and two multi-story burn towers at the site located at Farm to Market Road 306 in New Braunfels, Texas, in Comal County. It is understood that the proposed fire station, classroom building, and burn tower will each have a footprint of approximately 16500, 4,800, and 2,000 square feet (sf) respectively. This project also includes ancillary driveway and parking area pavements.

Engineering recommendations are provided on the basis of existing conditions at the time of drilling.

Scope of Services

The Texas Section of the American Society of Civil Engineers defines an engineered foundation as one that includes a geotechnical engineering investigation. To act as this first phase of an engineered foundation, our scope of work for this project consisted of:

1. Drilling 11 test borings at the selected locations within the project site to evaluate the subsurface arrangement of strata and groundwater conditions.
2. Performing geotechnical laboratory tests on recovered samples to evaluate the physical and engineering properties of the strata observed.
3. Engineering analysis to develop recommendations with respect to:
 - Site, subgrade, and fill preparation
 - Foundation design and construction
 - Pavement design and construction

SITE INVESTIGATION PROCEDURES

Subsurface conditions at the site were evaluated by drilling 11 borings at the locations shown on the *Project Layout* in the Appendix. These locations are approximate and distances were measured using a hand-held GPS locator. Between September 1 and 14, 2020, the borings for the structures were drilled to depths ranging between approximately 30 to 50 feet below the existing ground surface and the borings for the pavement were drilled to a depth of approximately 6 feet below the existing ground surface, using a truck-mounted drill rig.

The *Logs of Borings*, presenting the subsurface soil descriptions, type of sampling used, laboratory results, and additional field data, are presented in the Appendix. The *Symbols and Terms*, which defines the terms and descriptive symbols used on the logs, is also provided in the Appendix.

Samples were taken continuously for the first 10 feet in 2 foot increments. Below 10 feet, samples were taken at 5 foot intervals to the termination of the boring.

Samples of soil were obtained by means of a Split-Spoon with Standard Penetration Test (SPT). This test consists of measuring the number of blows required for a free-falling hammer to drive a standard Split-Spoon sampler 12 inches into the subsurface material after being seated 6 inches. The test is terminated after 50 blows regardless of

whether 12 inches of penetration has been achieved. If all 50 blows fall within the first 6 inches (seating blows), then refusal (Ref.) for 6 inches or less will be denoted on the *Logs of Borings*. This blow count, or SPT “N” value, is used to evaluate the engineering properties of the stratum. Correlations between the unconfined compressive strength and the “N” value for the in situ soils have been developed to estimate the bearing capacity of the soils.

All samples were removed from samplers in the field, visually classified, and sealed in sample containers to preserve their in situ moisture contents.

Throughout the report, the soils are referred to in terms used to describe their consistency. The term consistency refers to the degree of adhesion between the soil particles and to the resistance offered against forces that tend to deform or rupture the soil aggregate. Consistency of clays and other cohesive soils is usually described as very soft, soft, firm, stiff, very stiff, and hard. Additional consistency terms used on cohesive soils are plastic, lean, and fat. As a soil approaches the characteristics of a clay soil, the greater the variety of states of consistency in which it may be found. The physical properties of a plastic soil change depending upon the moisture content of the soil. The degree of plasticity is sometimes expressed by the terms fat and lean. Lean clay is only slightly plastic; whereas fat clay has a high plasticity.

LABORATORY TESTING

Samples obtained during the field program were visually classified in the laboratory by a geotechnical engineer or their representative. A testing program was conducted on selected samples in accordance with the ASTM Standard Test Procedures, as directed by the geotechnical engineer, to aid in classification and evaluation of engineering properties required for analysis.

The laboratory testing program for this project included sieve analyses, moisture contents, and Atterberg limits.

Sieve analyses were performed by passing the sample through a series of sieves to classify the soil based on their particle size. This allows a determination of the type of soils, distribution of the particle sizes and the interaction between the particles. Sieves used for this test include a series of screens of various sizes to determine the amount of various particle sizes in a sample.

Moisture content tests were performed in accordance with ASTM D 2216 by placing a sample into an oven with a constant temperature and comparing the mass before oven drying to the mass after oven drying. Changes in the moisture content have an effect on the behavior of plastic soils. Variations in the moisture content from the state observed during investigation to the moisture content from the state observed during construction can result in expansive soil-related movements. If the moisture content of the soil increases after construction, for example, the soil can induce uplift forces on the structure it is supporting.

The structure of clay consists of a random arrangement of flat plates. Edges of the particles are positively charged, and the face is negatively charged. Negative charges on the face of the clays bond with positive water ions in the soil, causing a volumetric change resulting in expansion of the soils. This water may be released with the application of

pressure from load, evaporation, or suction from gravity or vegetation. The specific chemical makeup of the various clays causes them to have a stronger or weaker ability to bond with water.

In order to relate moisture content and soil consistency, Atterberg limit tests were performed on the samples in accordance with ASTM D 4318. The Atterberg limit test is comprised of 2 separate tests: plastic limit and liquid limit. The plastic limit test determines the moisture content of the soil in its dry state while the liquid limit test determines the moisture content as the soil nears a liquid state.



The plastic limit is described as the moisture content of the soil where it transitions between brittle and plastic behavior. This point is determined by rolling the samples in threads 1/8 inch (3 mm) in diameter to the point at which they begin to crack and/or crumble.

The liquid limit describes the moisture content of the soil where it transitions between plastic and liquid behavior. In conducting this test, the sample is placed in the Casagrande cup, or liquid limit device. A standard grooving tool is used to create a gap in the center of the sample 0.53 inches (13.5 mm) in width. The cup is then dropped repeatedly onto the hard rubber base at a rate of 120 blows per minute. The liquid limit is the moisture content at which the groove closes at 25 blows.



The plasticity index (PI) is the difference between the liquid limit and the plastic limit and provides a description of the moisture states a soil can experience. The PI is an indicator of the potential for expansion or contraction of the soil.

Results of the laboratory tests are presented on the *Logs of Borings* in the Appendix and are discussed in the following sections. Samples will be retained in our laboratory for 30 days after submittal of this report.



All samples were returned to our laboratory in Georgetown, Texas. Samples not tested in the lab will be stored for a period of thirty (30) days subsequent to submittal of this report and will be discarded after this period, unless Gessner Engineering is notified otherwise. Whenever possible, samples are used to fill subsequently drilled borings, or used to fill washed out areas or holes to prevent adding unnecessary waste to landfills.

SITE CONDITIONS

Site Geology

Major soil formations provide information with regards to the depth and magnitude of the conditions, as well as anticipated features of the soils in this area. This information provides typical data for the area. While it is valid as a general reference, it does not provide data accurate enough to replace site specific engineering analysis.

The site is mapped as being underlain by the Leona Formation as indicated on the Geologic Atlas of Texas, San Antonio Sheet as published by the University of Texas at Austin. The Leona Formation is comprised of fine calcareous silt grading down into coarse gravel.

In addition, the Del Rio Clay Formation, Edwards Limestone Formation, Buda Limestone Formation, Eagle Ford Group Formation (shale, siltstone, and limestone), Austin Chalk Formation (chalk and marl), Pecan Gap Chalk Formation, and Fluvatile terrace deposits (clay, silt, sand, and gravel) are also mapped nearby. Although not specifically mapped at the site, these may be encountered at construction.

Surface Conditions

Based on online imagery, the topography is gently sloping across the proposed site. At the time of drilling, ground cover for the proposed site consisted of grass and weeds.

Due to the presence of the existing buildings and pavements in the vicinity of the proposed structures, there may be a number of buried structures and utilities throughout the area; it is also possible that abandoned foundations, structures, and utilities are present and not encountered during field operations. The presence of buried structures (old foundations, pavements, brick, debris, trash, abandoned utilities, etc.) should be

anticipated during construction. If these conditions are encountered during foundation construction, contact Gessner Engineering for additional recommendations prior to proceeding with construction.

Subsurface Conditions

Subsurface stratigraphy at this site in the vicinity of the **fire station (Borings BH-1 through BH-3)** can be generally described as clay overlying clayey sand or clayey gravel. Subsurface stratigraphy at this site in the vicinity of the **training classroom (Borings BH-4 and BH-5)** can be generally described as fill material overlying clay, overlying clay or clayey sand. Subsurface stratigraphy at this site in the vicinity of the pavements (**Borings PH-1 through PH-4**) can be generally described as clay or gravelly clay. Subsurface stratigraphy at this site in the vicinity of the **burn towers (Borings TH-1 and TH-2)** can be generally described as clayey gravel and clay overlying clayey sand, respectively. Each stratum has been designated by grouping soils that possess similar physical and engineering characteristics. The *Logs of Borings* should be consulted for more specific stratigraphic information. Lines designating the interfaces between strata on the logs represent approximate boundaries, and transitions between strata may be gradual.

These soils generally exhibit up to very high potential for volumetric change due to moisture variations, as indicated by the measured PI for each sample, which are presented on the *Logs of Borings* in the Appendix. The in situ moisture contents that correspond to the plastic limits found in each boring indicate that the soils were generally dry at the time of sampling. Moisture contents are compared to plastic limits to evaluate the conditions within the plastic state for the particular soil, as opposed to absolute values of moisture content.

Groundwater Conditions

The borings were dry augered to their completed depth in an attempt to observe groundwater conditions. Groundwater seepage was not observed in the borings drilling operations. It should be noted that groundwater at the site may occur in the form of “perched” water traveling along pervious seams or layers within the soils. The frequency of such groundwater is expected to increase during and soon after periods of wet weather.

The direction of flow of subsurface moisture is unknown and many times will differ from the surface topography. Caution should be taken when constructing in wet seasons and all water accumulated during construction shall be removed prior to concrete placement.

An extensive groundwater study is beyond the scope of this report. Should construction activities require further evaluation of groundwater volumes, seasonal fluctuations, and direction, contact Gessner Engineering.

ENGINEERING RECOMMENDATIONS

General Foundation Considerations

Review of the borings and test data indicates that the factors discussed below may affect foundation design and construction at this site. This information may be used to help mitigate possible movement due to settlement over the life of the structure.

Settlement of cohesionless soils is primarily controlled by compressibility, or the tendency of sands to settle or compress under loads. Compressibility is influenced by relative density, grain shape, mineralogy, grain size distribution, overburden pressure, water, precompression or in situ stress state, and cohesive impurities. Relative density and overburden pressure are the primary factors that affect compressibility of soils. Due to the relatively low loads of the structure acting on the in situ soils, overburden pressure is of minimal concern for this project. Settlement due to sands with a low relative density is more of a concern; however, if the site is properly compacted as recommended in the *Foundation Earthwork* section of this report, the foundation is expected to experience minimal settlement.

Some soils encountered in our borings are plastic and exhibit expansive soil-related movement properties. Structures constructed on-grade may experience differential movements due to volumetric changes of the underlying and surrounding soils.

Movement of expansive soils is caused by fluctuations in the moisture content of soil particles. Because homogeneous expansive clay soils have relatively low permeability compared to granular soils, fluctuations in the moisture content of the soils might normally be expected to occur over a long period. However, permeability is increased with geotechnical phenomena such as ground faults, surface fractures due to desiccation of clays, and decomposition of tree roots that cause fissures and cracks that become widely disseminated over time.

Due to the repeated wetting, swelling, drying, and shrinking of the clay as it weathers, the fissures often fill with silt and sand, and create pathways for water that can exacerbate the infiltration process. Water can also easily move through naturally occurring sand strata, sand seams, and micro-cracks in clay soil caused by previous shrinkage. High negative pressures, also known as suction, in clay soils with low water content also increase the tendency for water to be absorbed into the clay.

Environmental factors other than climatic conditions can also affect expansive soils. Soil shrinkage may be caused by water extraction by trees and other vegetation, a process known as transpiration. Swelling can be a result of water infiltration into the soil from lawn irrigation systems, broken water pipes, flooded and leaking utility trenches, poor drainage, or leaking swimming pools; or it can be a result of slow moisture replenishment and equalization after the removal of a tree. The combined effect and variability of all of these possibilities make it difficult to accurately predict expansive soil ground movements.

Foundation movements are considered problematic only if they result in negative phenomena that detrimentally affect the performance or appearance of a building. The negative phenomena are considered to be structural if the load carrying capacity of the superstructure or foundation elements are affected, or are considered to be cosmetic if only the appearance of the exterior cladding or interior wall, floor, or ceiling finishes are affected.

Foundation movements can also affect the serviceability of a building, such as the opening or closing of doors. This type of movement typically occurs because of differential movements between various parts of a building. Differential movements often lead to high internal stresses in building components and subsequent cracking and separating of exterior cladding systems such as brick, cement-board panels, or in the interior finishes such as gypsum drywall panels, wood paneling, and flooring.

Expansive Soil-Related Movements

Gessner Engineering has calculated the potential vertical rise (PVR) of the soils at this site using the Texas Department of Transportation Method Tex-124-E. Movement may be either heave or settlement depending on the changes in the moisture content. The PVR at this site in the vicinity of each structure is calculated and presented in the following table, assuming an active zone of 10 feet. Due to assumptions and generalities required for the calculation of the potential vertical movement, it should only be taken as an approximation. It should be noted that moisture variations in the subgrade soils due to poor drainage, perched water in pervious layers, leakage of utilities, etc. could induce volumetric changes resulting in movements that are in excess of those estimated by the PVR procedure.

Structure	Fire Station	Training Classroom	Burn Tower 1	Burn Tower 2
Existing PVR (inches)	2.75	2.25	1.00	1.00

Table 1: Expansive Soil-Related Movements for All Structures

Foundation Options

The following recommendations are based on the data obtained from our field and laboratory studies, our past experience with geotechnical conditions similar to those at this site, and our engineering design analyses.

The following alternatives are available to support the structures:

- Pier-Supported Structural Slab-on-Voids;
- Stiffened Slab-on-Grade.

These foundation alternatives are listed in order from lowest risk of expansive soil-related movements to highest risk of expansive soil-related movements. These foundation alternatives typically reduce in cost as the risk of expansive soil-related movements increases. The owner may select either one of these foundation systems depending on the performance criteria established for the structures. Cost analyses have not been conducted for any foundation system and are beyond the scope of this study.

The **structural slab-on-voids foundation system** is the primary recommendation for all the structures at this site because of its minimal risk for differential movement. In any construction project, the design must balance the construction cost with performance. In this instance, a secondary option is presented for the fire station and training classroom buildings that may provide a more cost-effective solution, while sacrificing some performance benefits of a slab-on-voids foundation system. The soils on this site combined with the recommended foundation earthwork

make this option feasible. If properly designed and constructed, the **stiffened slab-on-grade foundation system** can provide adequate foundation support with minimal deflections and maintenance to finishes over the life of the structure.

Structural Slab-on-Voids – All Structures

A structural slab isolates the foundation from the soils through the use of void forms, a crawl space, or another method. These foundations are typically employed when the amount of site preparation required to reduce the PVR value to acceptable levels for a slab-on-grade foundation system would be equivalent or in excess of the cost of a slab-on-void system or when a structure is sensitive to movement. The principle behind structural elevated foundation systems is to found the structure on deep, stable soils or rock that is unlikely to be affected by seasonal changes to the shallow soils. The deep founding elements are typically piles or piers. The floor system is constructed above the shallow soils. This isolation from the surficial soils prevents damages caused by periodic shrinkage and heave of expansive clays.

The minimum amount of soil separation between the shallow foundation elements and the subgrade shall be **6 inches**. Shallow soils at site have sufficient cohesion to remain stable during excavation of earth formed grade beams. Grade beam width and depth should be properly evaluated by the structural engineer and designed to span from pier to pier. It is also recommended that a vapor barrier be placed between the supporting soils and the concrete floor slab in accordance with ASTM E 1745-11, ASTM E 1643-11, and ACI 302.2R-06. Piers shall be designed in accordance with the *Deep Foundations* section of this report.

For the long-term effectiveness of void systems, earth retainers shall be employed to protect the void. Where an interior crawl space is provided or the interior soils and fill have sufficient cohesion to remain open, perimeter earth retainers may be used. Earth retainers shall be placed with a secure overlap against a formed concrete surface and keyed into firm soil to provide adequate support at the top and bottom of the retainer against lateral earth pressure. In full slab-on-void systems, it is recommended that earth retainers be installed on both sides of beams and excavations. This installation protects against interior collapses where soils have been disturbed by construction activities. The retainers may be placed in a manner similar to that for exterior earth retainers as described previously, or may be set prior to the pour. Should the earth retainers be set prior to the pour, they shall be either keyed into the soil below to provide support at top and bottom or be designed and supported to cantilever over the void. Cantilevered earth retainers typically require a more rigid earth retainer and extend up the grade beam a minimum distance of twice the void depth.

In foundations with crawl spaces, adequate ventilation and drainage in accordance with code requirements should be provided to minimize moisture accumulation within the crawl space.

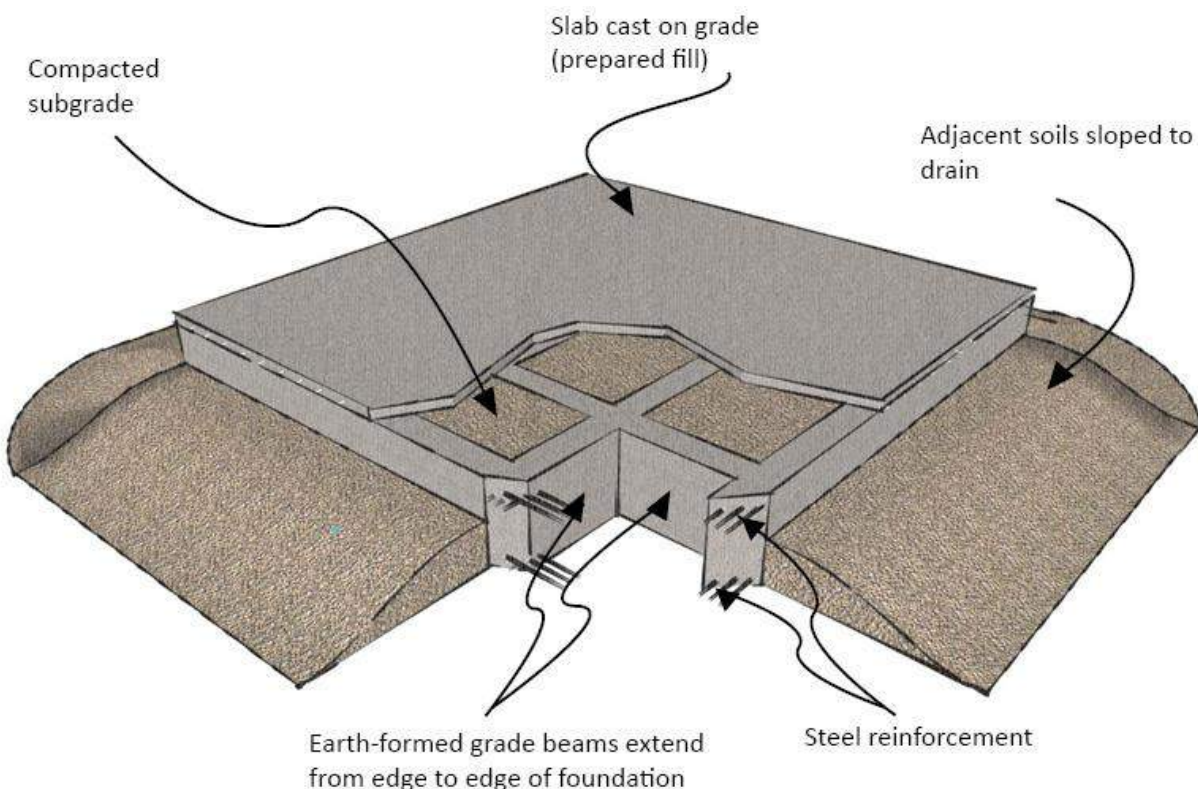
Care should be taken in all foundation systems to provide adequate drainage around the structure and prevent ponding of runoff adjacent to the foundation. In addition, systems that extend from the building into the shallow soils such as plumbing should be designed to accommodate the movement of the shallow soils. Where utilities extend beyond the interior voids into natural soil or fill at the exterior face of the structure, flexible connections should be used. Gessner Engineering recommends the use of proprietary utility void systems to create a protected void that maintains the required clearance below the structure.

Subgrade for the structural slab foundation system shall be prepared in accordance with the foundation portion of the soil preparation section of this report.

Stiffened Slab-on-Grade

A stiffened slab-on-grade, also known as a waffle slab or modified mat foundation, consists of a slab stiffened with beams spanning across the foundation in each direction. Stiffened slab-on-grade foundations are appropriate for foundations on expansive soils that are sensitive to deflection. Grade beams in these foundations should extend from edge to edge across the slab. The network of grade beams is intended to create a rigid plate that moves as a unit in response to soil movement.

Parameters for the foundation design presented here are provided for the methods recommended by the Texas Branch of the American Society of Civil Engineers. Should the design engineer require additional parameters, please contact Gessner Engineering.



Conventionally Reinforced System

The primary role of steel reinforcement in reinforced concrete is to carry the tensile forces due to flexure of the beams. Concrete has high compressive strength but lacks tensile strength. The conventionally reinforced stiffened slab-on-grade uses steel reinforcement in the grade beams to create the necessary stiffness in the foundation. Increasing the grade beam depth and size of reinforcement and decreasing the beam spacing provides additional stiffness for more expansive soils.

Presented below are our recommended design parameters for the Building Research Advisory Board (B.R.A.B.) design method and the Wire Reinforcement Institute (W.R.I.) design method based upon the subsurface conditions observed at this project location. These methods are essentially empirical design techniques and the parameters provided are based on our interpretation of the project soil borings and criteria published in the B.R.A.B. design manual and the W.R.I. design manual.

It is recommended that this site use an overexcavation and select fill replacement as recommended in the following table. This recommended overexcavation and select fill replacement and a properly constructed building pad in accordance with the *Foundation Earthwork* section of this report corresponds to a design effective PI values presented in the following table. The design effective PI values are recommended based on our experience using the B.R.A.B. and W.R.I. methods of foundation design.

Allowable bearing pressure values for the soils or select fill below ground surface with a properly prepared building pad are presented in the following table. This allowable bearing capacity was calculated with a factor of safety of 3. Other measures recommended to reduce moisture infiltration into the subgrade are presented later in this subsection and in the *Drainage* section of this report. Presented in the table below are effective design parameters for this site after the recommended earthwork is performed.

Design Parameters	Fire Station	Training Classroom	Burn Tower 1	Burn Tower 2
Existing Material to be overexcavated (feet)	4.0	2.0	2.0	2.0
Select Fill to be compacted in place (feet)	4.0	2.0	2.0	2.0
Design Effective PI	20	30	33	20
Design PVR (inches)	1.25	2.00	1.00	1.00
Allowable Bearing Capacity (psf)	3,000	3,000	3,000	2,300
Climatic Rating	17	17	17	17
Soil Support Index (SSI)	0.95	0.84	0.81	0.95

Table 2: B.R.A.B. or W.R.I. Design Parameters

It is recommended that grade beams extend a minimum of 12 inches below final grade into properly compacted earth or select fill. This recommendation is to reduce surface water migration below the foundation elements and to develop proper bearing of the grade beams. According to Section 1809.4 of the 2018 International Building Code, the foundation is required to bear 12 inches below the adjacent soil. Grade beam width and depth should be properly evaluated by the structural engineer. Grade beams may be thickened and widened at column locations to serve as spread footings to support concentrated loads. It is also recommended that a vapor barrier be placed between the supporting soils and the concrete floor slab in accordance with ASTM E 1745-11, ASTM E 1643-11, and ACI 302.2R-06.

For a stiffened slab-on-grade foundation, it is recommended that measures be taken whenever practical to increase the tolerance of the structure to post-construction foundation movements. An

example of such measures would be to provide frequent control joints for masonry/brick/stucco veneer exteriors, if any, to control cracking across such walls and concentrate movement along the joints.

Care should be taken in all foundation systems to provide adequate drainage around the structure and prevent ponding of runoff adjacent to the foundation. Reference the *Drainage* section of this report for additional resources. In addition, systems that extend from the building into the shallow soils such as plumbing should be designed to accommodate the movement of the shallow soils.

Subgrade for a stiffened slab-on-grade foundation system shall be prepared in accordance with the *Foundation Earthwork* section of this report.

Deep Foundations

Based on the current available project information and the soils data obtained, drilled piers or other deep foundation elements are recommended for a structural slab-on-voids, but are not anticipated for a stiffened slab-on-grade foundation. If used, piers shall be drilled, straight-shaft piers. Founding soils at this site should provide sufficient cohesion to be able to remain stable during the augering of the shaft.

Straight-shaft piers should be designed as friction units using an allowable side shear resistance as described in the table below for the portion of the shaft extending below a depth of 10 feet below the existing ground surface. This allowable side shear resistance was evaluated using a calculated factor of safety of at least 2.

Pier Bearing Depth (feet)	Pier Bearing Stratum	Shear Resistance Capacity (ksf)			
		Fire Station	Training Classroom	Burn Tower 1	Burn Tower 2
10 - 18	Brown and Tan Clay or Tan Clayey Sand or Clayey Gravel	0.70	0.75	0.75	0.65
18 - 23	Tan Clayey Sand or Clayey Gravel	0.80	0.75	0.85	0.80
23 - 28	Tan Clay or Clayey Sand or Clayey Gravel	0.90	0.90	0.85	0.85
28 - 30	Tan Clayey Sand or Clayey Gravel	1.00	0.95	1.00	0.95
30 - 38	Tan Clayey Sand or Clayey Gravel	-	-	1.00	-
38 - 45	Tan Sandy Clay	-	-	1.10	-
45 - 48	Tan Clayey Gravel	-	-	1.30	-

Table 3: Allowable Straight-Shaft Shear Resistance for All Structures

Drilled, straight-shaft piers may also be proportioned using a maximum allowable end bearing pressure as described in the following table at the corresponding depths below the existing ground surface. If end bearing capacity is included in the pier capacity for structural design, the side shear resistance should be neglected along the portion of the shaft located one shaft diameter from the

bottom of the pier. In addition, we recommend that a minimum of 70 percent of the applied load be carried in side shear.

Pier Bearing Depth (feet)	Pier Bearing Stratum	End Bearing Capacity (ksf)			
		Fire Station	Training Classroom	Burn Tower 1	Burn Tower 2
18 - 23	Tan Clayey Sand or Clayey Gravel	20.00	18.00	20.00	20.00
23 - 28	Tan Clay or Clayey Sand or Clayey Gravel	15.00	18.75	20.00	17.50
28 - 30	Tan Clayey Sand or Clayey Gravel	20.00	18.75	20.00	18.00
30 - 38	Tan Clayey Sand or Clayey Gravel	-	-	20.00	-
38 - 45	Tan Sandy Clay	-	-	13.75	-
45 - 48	Tan Clayey Gravel	-	-	20.00	-

Table 4: Allowable Straight-Shaft End Bearing Capacity for All Structures

Pier Shaft Potential Uplift Forces

The pier shafts will be subject to potential uplift forces if the surrounding expansive soils within the active zone are subjected to alternate drying and wetting conditions. The maximum potential uplift force acting on the shaft may be estimated by:

<i>Formula 1: Pier Shaft Potential Uplift Force</i> $F_u = D_f \times D$ Where: F_u = uplift force in kips; D_f = Depth Factor D = diameter of the shaft in feet.

The depth factors for calculating the pier shaft potential uplift force for the straight-shaft piers at this site are presented in the following table.

Structure	Fire Station	Training Classroom	Burn Tower 1	Burn Tower 2
Depth Factor	62.5	28.7	10.0	45.5

Table 5: Depth Factor for Pier Shaft Potential Uplift Force

Allowable Uplift Resistance

Resistance to uplift forces exerted on the drilled, straight-shaft piers will be provided by the sustained compressive axial force (dead load) plus the allowable uplift resistance provided by the soil. The resistance provided by the soil depends on the shear strength of the soils adjacent to the pier shaft

and below the depth of the active zone. The allowable uplift resistance provided by the soils at this site may be estimated using 2/3 of the axial compressive side shear resistance for the portion of the shaft extending below a depth of 10 feet. The allowable uplift resistance values for varying depths are presented in the following table. These values were evaluated using a factor of safety of 2.

Pier Bearing Depth (feet)	Pier Bearing Stratum	Shear Uplift Resistance Capacity (ksf)			
		Fire Station	Training Classroom	Burn Tower 1	Burn Tower 2
10 - 18	Brown and Tan Clay or Tan Clayey Sand or Clayey Gravel	0.45	0.50	0.50	0.40
18 - 23	Tan Clayey Sand or Clayey Gravel	0.50	0.50	0.55	0.50
23 - 28	Tan Clay or Clayey Sand or Clayey Gravel	0.60	0.60	0.55	0.55
28 - 30	Tan Clayey Sand or Clayey Gravel	0.65	0.60	0.65	0.60
30 - 38	Tan Clayey Sand or Clayey Gravel	-	-	0.65	-
38 - 45	Tan Sandy Clay	-	-	0.70	-
45 - 48	Tan Clayey Gravel	-	-	0.85	-

Table 6: Allowable Straight-Shaft Shear Uplift Resistance for All Structures

Piers shall not be spaced closer than 3 times the pier diameter, center-on-center, without decreasing the pier capacity. It is recommended that piers be reinforced with minimum area of reinforcement of 0.5 percent of the pier cross sectional area to resist tensile forces on the pier from expansion of the clays in contact with it. Piers shall be designed to resist uplift from the expansive soils.

For bid purposes, the owner should anticipate that deeper piers will be required in some areas. Consequently, contractors bidding on the job should include unit costs for various depths of additional pier embedment. Unit costs should include those for both greater and lesser depth in soil.

Water encountered during pier drilling shall be removed prior to the concrete pour. Piers must be poured the same day they are drilled; pier shafts shall *not* be left open overnight. Piers that are unable to be poured on the same day as they are drilled shall be backfilled overnight.

Temporary Casing

Groundwater seepage was not observed in the test borings at the time of our subsurface exploration. However, groundwater seepage and/or side sloughing may be encountered at the time of construction, depending on climatic conditions prevalent at the time of construction. Therefore, it is recommended that the bid documents require the foundation contractor to specify unit costs for different lengths of casing that may be required.

Earthwork

During earthwork, best practices shall be applied to limit erosion and pollution by sedimentation. At all times, the contractor shall work to maintain natural drainage and prevent the accumulation of runoff.

To achieve the required moisture content, the following recommendations are included as an aid to contractors. Where subgrade or layer of soil material requires moisture before compaction, uniformly apply water to surface of subgrade. Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density. Soil material that has been removed because it is too wet to achieve compaction may be stockpiled or spread and allowed to dry. Assist drying by discing, harrowing, or pulverizing until moisture content is reduced to a satisfactory value. Alternate methods to achieve the end result of specified moisture content and compaction may also be used.

Four different methods may be utilized to successfully compact the soil. They include the processes of static weight, kneading action, impact, or vibration. Soil must be compacted using a compactor in accordance with the ASTM standards. A compactor is required to compact the soil to such a large degree. Track equipment such as bull dozers apply pressure across a large surface area and are therefore limited in their capabilities compared to a compactor. If the fill is not compacted properly, the fill material and structures constructed on it are subject to settlement.

Foundation Earthwork

The following earthwork recommendations are provided for the design parameters as described previously in the report. For a **structural slab-on-voids foundation system** at this site, it is recommended that a minimum of **6 inches** of existing material be overexcavated and general fill be compacted in place as needed to form a level building pad. For all structures, for a **stiffened slab-on-grade foundation system** at this site, it is recommended that existing material be overexcavated and select fill be compacted in place to form a level building pad presented in the following table. If the surficial material is processed of roots, vegetation, and deleterious materials, it may be used as select fill provided that it meets the select fill requirements in the following section. The building pad shall extend a minimum of 5 feet from the edge of the building footprint in all directions. Select fill shall slope away at an angle that allows for proper drainage (see *Drainage* section).

Earthwork Foundations	Fire Station	Training Classroom	Burn Tower 1	Burn Tower 2
Existing Material to be overexcavated (feet)	4.0	2.0	2.0	2.0
Select Fill to be compacted in place (feet)	4.0	2.0	2.0	2.0

Table 7: Earthwork Recommendations for Stiffened Slab-on-Grade Foundation System

Construction areas should be stripped of all vegetation, loose topsoil, surficial concrete, etc. Roots of trees within the proposed building footprint should be excavated and removed from the construction area. Once final subgrade elevation has been achieved, exposed soil subgrade areas shall be proof rolled with a 15 ton roller (minimum) or equivalent equipment as approved by the engineer to detect weak zones. Weak areas detected during the proof rolling process, as well as zones containing debris and/or organics and voids resulting from removal of tree roots, etc., should

be removed and replaced with soils exhibiting similar classification, moisture content, and density as the adjacent in situ soils. Finally, the minimum amount of fill shall be placed to evenly build up the pad. Fill amounts may be increased to raise the building pad to the desired finished floor elevation or to decrease the movement potential of the site.

General Fill

General fill to be used beneath a structural slab-on-voids shall have a PI no greater than 30 and shall be free of debris and organics. All general fill should be placed on prepared surfaces in lifts not to exceed 8 inches loose measure, with compacted thickness not to exceed 6 inches. General fill should be compacted to at least 92 percent of the Standard Proctor (ASTM D 698) density at a moisture content ranging within 2 percent of optimum moisture content.

Select Fill

Select fill to be utilized beneath the stiffened slab-on-grade limits should consist of a low plasticity soil with a PI between 8 and 20, percentage retained on No. 4 sieve of 35 - 75 percent (gravel content), percentage retained on the No. 40 sieve of 60 - 90 percent (coarse sand content), and rocks no larger than 2 inches in their largest dimension; or a crushed limestone base material meeting the requirements of the Texas Department of Transportation (TxDOT) 2004 Standard Specifications Item 247, Type A, Grade 3. Alternatively, a low-plasticity granular fill material that does not meet these specifications may be utilized only if approved by Gessner Engineering. All select fill should be placed on prepared surfaces in lifts not to exceed 8 inches loose measure, with compacted thickness not to exceed 6 inches. Select fill should be compacted to at least 95 percent of the Standard Proctor (ASTM D 698) density at a moisture content ranging within 2 percent of optimum moisture content for depths of 3 feet or less. If fill in excess of 3 feet is required, all select fill deeper than 3 feet shall be compacted to 98 percent of Standard Proctor (ASTM D 698).

Site Fill

For site areas not below pavements or ground-supported structures, general fill may be used to achieve the desired grade. All surficial backfill material within 5 feet of the foundation perimeter for the top foot of soil may be installed as a clay cap on fill materials to prevent migration of surface water beneath the structure. This material shall be placed as noted above and shall have a PI in excess of 30. Fill shall be free of debris and organics and shall be placed in accordance with the *Drainage* section of this report.

Utility Trench Fill

The upper portion of utility excavations should be backfilled with properly compacted clay soils to minimize infiltration of surface water. A clay “plug” should be provided in the trench on the exterior of the building to prevent water from gaining access along the trench to the subgrade beneath the structure. This plug shall extend 2 feet beyond the pipe face in all directions and be a minimum of 2 feet thick.

Drainage

The performance of the foundation system for each proposed building will not only be dependent upon the quality of construction, but also upon the stability of the moisture content of the near surface soils. Therefore, Gessner Engineering recommends that site drainage be developed so that ponding of surface runoff near the structure does not occur. Accumulation of water near the structure foundation may cause moisture variations in the soils adjacent to the foundation, thus increasing the potential for structural distress.

Slope adjacent to foundations is addressed in Section 1804.4 of the 2018 International Building Code, which requires a 5 percent slope in the first 10 feet. Where sites do not allow this, the code allows drainage structures to accommodate the runoff. It should be noted that this requirement conflicts with accessibility standards, which would govern at entrances and other travel paths

Pavement Recommendations

Recommendations for both rigid and flexible pavements are presented in this report. The Owner and/or design team may select either pavement type depending on the performance criteria established for the project. In general, flexible pavement systems have a lower initial construction cost as compared to rigid pavements. However, maintenance requirements over the life of the pavement are typically much greater for flexible pavements. This typically requires regularly scheduled observation and repair, as well as overlays and/or other pavement rehabilitation at approximately one-half to two-thirds of the design life. Rigid pavements are generally more durable and require less maintenance after construction.

For either pavement type, drainage conditions will have an impact on long-term performance, particularly where permeable base materials are utilized in the pavement section. Pavement design should be in accordance with the *Pavement Drainage Considerations* section of this report.

Subgrade Conditions

Gessner Engineering assumes that the subgrade in pavement areas will consist of the recompacted on-site materials, placed and compacted as recommended in the *Pavement Earthwork* section of this report. Based on our experience with similar subgrade soils, a California Bearing Ratio (CBR) value of 3.0 has been assigned for use in flexible pavement thickness design analyses.

Design Information

Rigid pavement recommendations were prepared assuming traffic categories A for light -duty and C for heavy-duty pavements. An average daily truck traffic (ADTT) of 10 and 300 were assigned for light and heavy-duty pavements, respectively. Flexible pavement recommendations were prepared assuming a 20-year design life and Equivalent Single Axle Loads (ESAL's) of 50,000 for light-duty pavements (parking areas) and 250,000 for heavy-duty pavements (main drives, fire lanes).

The Project Civil Engineer should review anticipated traffic loading and frequencies to verify that the assumed traffic loading and frequency is appropriate for the intended use of the facility.

Rigid Pavement

It is recommended that rigid pavements be considered in areas of channelized traffic, particularly in areas where truck or bus traffic is planned, and particularly where such traffic will make frequent turns, such as garbage dumpsters as described in the *Garbage Dumpsters* section of this report.

For the concrete parking lots, sidewalks and drives, frequent control joints should be used to direct shrinkage cracking with a maximum joint spacing as shown in the table below. It should be noted that the pavement thicknesses listed are minimum recommendations only and are not based on a pavement system design. Expansion joints shall be placed at anticipated stress points and dowels shall be placed across these joints. The concrete section may be reinforced and designed in accordance with ACI standard practices or may be designed as a jointed system in accordance with ACI 330R-08.

Subgrade stabilization shall comply with the *Subgrade Treatment* section of this report, with thickness as described in the following table.

Loading	Concrete Thickness (inches)	Stabilized Subgrade Thickness (inches)	Control Joint Maximum Spacing (feet)
Sidewalks	4.0	6.0	Sidewalk Width
Light-Duty Pavements	5.5	6.0	12.5
Heavy-Duty Pavements	7.5	6.0	15.0

Table 8: Rigid Pavement System Recommendations

It is recommended that the concrete pavements be reinforced with bar mats. Concrete reinforcing should be placed approximately 1/3 the slab thickness below the surface of the slab, but not less than 2 inches. In thinner slabs, the reinforcement should be centered in the slab. Reinforcing should not extend across expansion joints.

All control joints should be formed or sawed to a depth of at least 1/4 the thickness of the concrete slab. Sawing of control joints should begin as soon as the cutting can be performed without raveling of the concrete. Control joints may be hand formed or formed by using a premolded filler. It is recommended that all longitudinal and transverse construction joints be dowelled to promote load transfer. Expansion joints are needed to separate the concrete slab from fixed objects such as drop inlets, light standards and buildings. No expansion or construction joints should be located in a swale or drainage collection locations.

Based on Formula 3-3 in the ACI 330R-08 Guide for the Design and Construction of Concrete Parking Lots, the minimum area of steel required for a reinforced section shall be computed by the drag formula:

Formula 2: Drag Formula

$$A = \frac{(LC_f wh)}{24f_s}$$

Where:

A = area of steel reinforcement (in²/ft)
 L = distance between joints (ft)
 C_f = Coefficient of subgrade resistance (use 1.5)
 w = density of concrete (lb/ft³)
 h = slab thickness (in)
 f_s = allowable tensile stress in steel reinforcement (psi)

If possible, the pavement should develop a minimum slope of 0.015 feet/feet to provide surface drainage. Reinforced concrete pavement should cure a minimum of 3 and 7 days before allowing automobile and truck traffic, respectively.

Portland Cement Concrete

Portland cement concrete should have a maximum slump of 5 inches and should have a minimum 28-day compressive strength of 4,000 psi. Air entrainment is recommended and should meet the recommendations as outlined in ACI-330R-08, Table 4.1. A liquid membrane-forming curing compound should be applied as soon as practical after broom finishing the concrete surface. The curing compound will help reduce the loss of water from the concrete. The reduction in the rapid loss in water will help reduce shrinkage cracking of the concrete.

The M_r of concrete is a measure of the flexural strength of the concrete as determined by breaking concrete beam test specimens. An M_r of approximately 500 psi at 28 days was used in the analysis and is typical of local concrete production.

Garbage Dumpsters

Where flexible pavements are constructed at any site, it is recommended that reinforced concrete pads be provided in front of and beneath trash receptacles. Dumpster trucks, if any, should be parked on the rigid pavement when trash receptacles are lifted.

It is suggested that such pads also be provided in drives where the dumpster trucks make turns with small radii to access the receptacles. Concrete pads at this site should be a minimum of 6 inches thick and reinforced with conventional steel reinforcing bars.

Sidewalks

Concrete sidewalks are planned throughout the facility for pedestrian traffic. It is recommended that subgrade stabilization be extended beneath sidewalks to reduce movement that would interfere with required ADA specifications. Reference the concrete section above and subgrade section below for details.

Flexible Pavement

Flexible pavement sections recommended for this site are as listed in the table below:

Loading	Options	Asphaltic Concrete Thickness (inches)	Flexible Base Course Thickness (inches)	Stabilized Subgrade Thickness (inches)
Light-Duty Pavements	Option 1	2.0	8.0	6.0
	Option 2	2.5	6.0	6.0
Heavy-Duty Pavements	Option 1	3.0	10.0	6.0
	Option 2	3.5	8.0	6.0

Table 9: Flexible Pavement System Recommendations

Flexible Base Course

Flexible base course should be crushed limestone conforming to TxDOT Standard Specifications, Item 247, Type A, Grades 1 or 2. Base course should be placed in lifts with a maximum thickness of 8 inches and compacted to a minimum of 95 percent of the maximum density at a moisture content within the range of 2 percentage points below to 2 percentage points above the optimum moisture content as determined by Tex-113-E.

Asphaltic Concrete Surface Course

Asphaltic concrete surface course should conform to TxDOT Standard Specifications, Item 340, Type D. Asphaltic concrete should be compacted to a minimum of 92 percent of the maximum theoretical specific gravity (Rice) of the mixture determined according to Test Method Tex-227-F. Pavement specimens, which shall be either cores or sections of asphaltic pavement, will be tested according to Test Method Tex-207-F. The nuclear-density gauge or other methods that correlate satisfactorily with results obtained from project roadway specimens may be used when approved by the Engineer. Unless otherwise shown on the plans, the Contractor shall be responsible for obtaining the required roadway specimens at their expense and in a manner and at locations selected by the Engineer.

Subgrade Treatment

The type of subgrade treatment to stabilize soils on the site depends on the type of soil located under pavements. The site is characterized by high-plasticity clays and/or less cohesive material on the surface. Lime stabilization works by reacting chemically with clay, but it does not react properly with sand. In field evaluation is required to determine the required method. Subgrade treatment will add a structural component to the pavement section, and it is also recommended to provide a weather-resistant and workable surface for construction activity. It should be noted that stabilization

recommendations are based on current grades. Should the site grading modify the surficial soils, variations from anticipated stabilization may be required. Stabilization shall meet local building code requirements.

Lime

Some soils at this site are highly plastic and can be difficult to work with, particularly during periods of inclement weather. To provide a suitable, weather-resistant working surface for construction activity, the upper 6 inches of the plastic subgrade clays be treated with hydrated lime.

Lime treatment of the subgrade soils, should be in accordance with the TxDOT Standard Specifications, Item 260. A sufficient quantity of hydrated lime should be mixed with the subgrade soils to reduce the soil-lime mixture PI to 18 or less. For estimating purposes, it is recommended that 6 percent lime by weight be assumed for treatment. **For construction purposes, it is recommended that the optimum lime content of the subgrade soils be determined by laboratory testing.** Lime-treated subgrade soils should be compacted to a minimum of 95 percent of the maximum density at a moisture content within the range of optimum moisture content to 3 percentage points above the optimum moisture content as determined by Tex-114-E.

If lime treatment is considered as a method to improve pavement subgrade conditions, it is recommended to perform additional laboratory testing to determine the concentration of soluble sulfates in the subgrade soils to investigate the potential for a recently reported adverse reaction to lime in certain sulfate-containing soils. The adverse reaction, referred to as sulfate-induced heave, has been known to cause cohesive subgrade soils to swell in short periods of time, resulting in pavement heaving and possible failure.

Cement

Some of the near-surface soils at this site are sandy or gravelly. Therefore, it is recommended that cement be used to stabilize the cohesionless material at this site. To provide a suitable, weather-resistant working surface for construction activity, the upper 6 inches of the cohesionless subgrade sand shall be treated with cement.

Gessner Engineering recommends the use of cement stabilizer for the treatment of the sand subgrade to help enhance the support characteristics of the subgrade. Subgrade shall be treated to a depth resulting in a 6 inch thick subgrade. Subgrade should be treated with cement meeting the requirements of TxDOT 2004 Standard Specifications Item 275. Cement treatment shall be accomplished such that a uniform subgrade mix is obtained. **Prior to the application of cement to the subgrade, the optimum percentage of cement to be added should be determined in the laboratory based on compressive strength tests on samples with varying percent cement and prepared in accordance with TEX-120-E.** The required cement selected shall provide a minimum strength of 50 psi. Cement shall be uniformly spread and mixed into the subgrade prior to the application of water. Stabilization shall be mixed and compacted in 1 lift and shall be completed the same day.

Stabilization Considerations

It is important that proper perimeter drainage be provided so that infiltration of surface water from unpaved areas surrounding the pavement is minimized, or if this is not possible, curbs should extend through the base and into the subgrade. A crack sealant compatible to both asphalt and concrete should be provided at concrete-asphalt interfaces. It should be noted that post-construction subgrade movements and cracking of asphaltic pavements is not uncommon for subgrade conditions such as those observed at this site.

Pavement Earthwork

If required, fill used beneath pavement shall have a PI between 8 and 30. Any fill beneath pavement shall be compacted to a minimum of 95 percent of the maximum density as determined by the modified moisture/density relation (ASTM D 1557) at -2 to +2 percent of the optimum moisture content. (As an alternative, compaction to at least 98 percent of the ASTM D 698 maximum dry density may be considered). The top portion of fill shall be chemically stabilized as recommended in the *Subgrade Treatment* section of this report.

Pavement Drainage Considerations

As with any soil-supported structure, the satisfactory performance of a pavement system is contingent on the provision of adequate surface and subsurface drainage. Insufficient drainage that allows saturation of the pavement subgrade and/or the supporting granular pavement materials will reduce the performance and service life of the pavement systems.

Surface and subsurface drainage considerations crucial to the performance of pavements at this site include (but are not limited to) the following:

- 1) Any known natural or man-made subsurface seepage at the site that may occur at sufficiently shallow depths as to influence moisture contents within the subgrade should be intercepted by drainage ditches or below grade French drains.
- 2) Final site grading should eliminate isolated depressions adjacent to curbs which may allow surface water to pond and infiltrate into the underlying soils. **Curbs should completely penetrate subgrade materials and should be installed to sufficient depth to reduce infiltration of water beneath the curbs.**
- 3) Pavement surfaces should be maintained to help minimize surface ponding and to provide rapid sealing of any developing cracks. These measures will help reduce infiltration of surface water downward through the pavement section.

Other Issues

Large trees adjacent to foundations should be avoided, as they can affect soil moisture contents significantly by creating concentrations of dry soils around the trees. If trees adjacent to a foundation cannot be avoided, property owners should maintain the drip line of the trees, which is typically consistent with the root system and can help keep the root system from causing foundation issues.

Maintenance of the entire landscape is a good practice for maintaining consistent moisture contents and minimizing foundation movement. Proper landscape maintenance uses vegetation as a natural moisture content indicator, as both over and under watering will result in distress of the plants.

Any elements that can affect the moisture content of the soils supporting a foundation, such as pools or plumbing, pose a risk to foundations. Care should be taken to prevent and quickly repair any leaks to minimize foundation damage.

Care should be taken when constructing adjacent to slopes to prevent bearing capacity failure due to nearby slope failure. For slopes steeper than 1 to 1, Section 1808.7.2 of the 2018 International Building Code recommends a minimum set back from slopes of 15 feet or one-half the height of the slope

Construction Materials Testing

The performance of foundation systems and pavements is dependent upon the quality of construction. Compaction testing of fill material and concrete strength tests are required by the 2018 International Building Code. Therefore, it is recommended that Gessner Engineering monitor foundation installation to identify the proper founding strata and depths and to help evaluate building pad and foundation construction. We would be pleased to develop a plan for foundation monitoring to be incorporated in the overall quality control program. For more information, please contact Gessner Engineering's dedicated dispatch number for materials testing at 979-325-TEST (8378).

General Comments

Shallow foundation excavations should be observed by the Geotechnical Engineer or their representative prior to placement of reinforcing steel and concrete. This is necessary to observe that the founding soils at the bottom of the excavations are similar to those encountered in our borings and that excessive loose materials and water are not present in the excavations. If soft pockets of soil are encountered in the foundation excavations, they should be overexcavated and replaced with a compacted non-expansive fill material or lean concrete up to the design foundation bearing elevations. Gessner Engineering would be pleased to provide foundation design review, foundation inspection prior to the concrete pour, and construction materials testing.

The analysis and recommendations presented in this report are based upon the data obtained from the borings performed at the indicated locations and from other information discussed in this report. This report does not reflect variations that may occur between borings, across the site or due to the modifying effects of weather. The nature and extent of such variations may not become evident until during or after construction. If variations appear, Gessner Engineering should be immediately notified so that further evaluation and supplemental recommendations can be provided.

Limitations

The scope of services for this project does not include, either specifically or by implication, any environmental or biological (e.g., mold, fungi, and bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials, or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

For any excavation construction activities at this site, all Occupational Safety and Health Administration (OSHA) guidelines and directives should be followed by the Contractor during construction to ensure a safe working environment. In regards to worker safety, OSHA Safety and Health Standards require the protection of workers from excavation instability in trench situations.

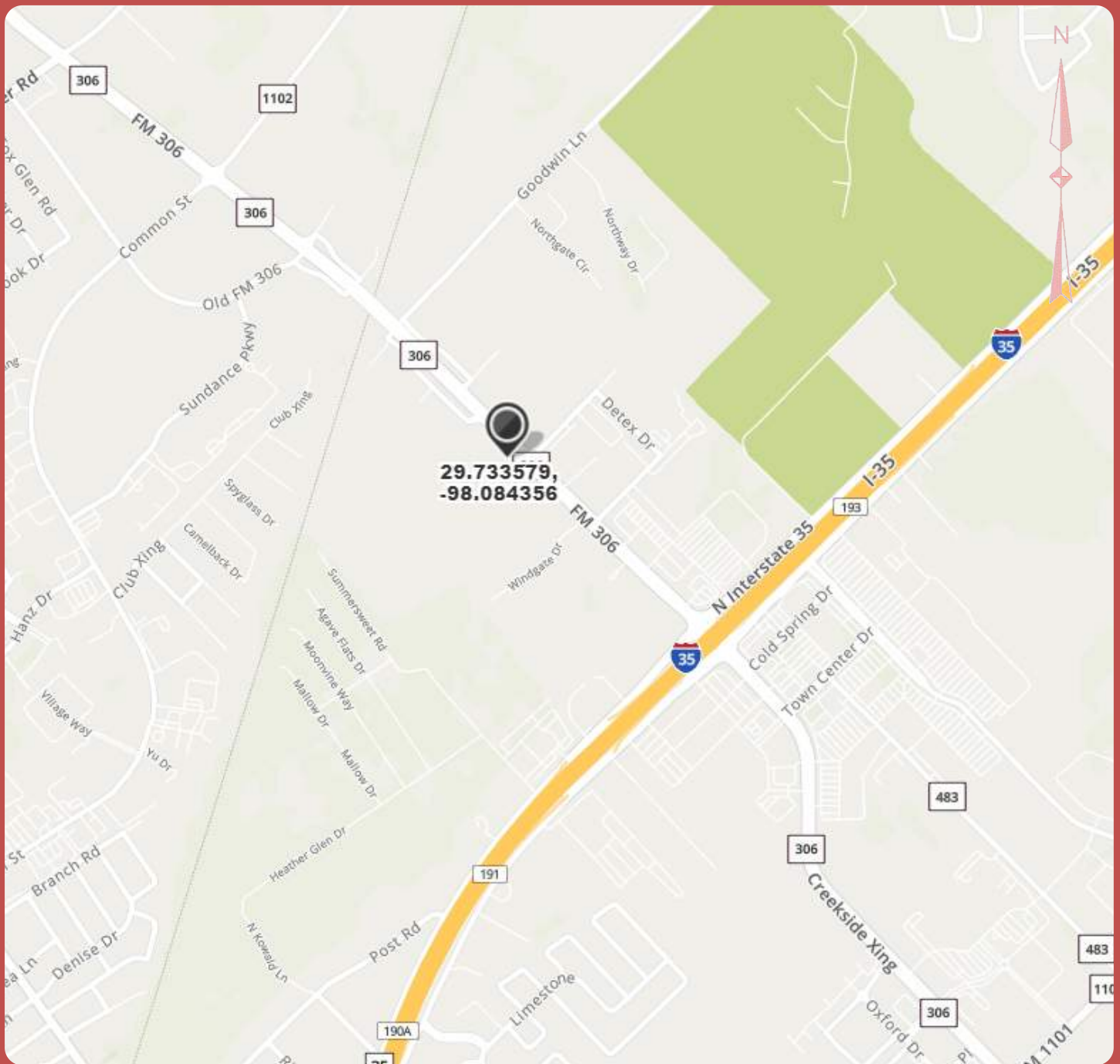
This report has been prepared for the use of Mr. Ray Holliday with Brown Reynolds Watford Architects and their design representatives for the specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. This report was written and recommendations were made based on the soil data collected between September 1 and 14, 2020. If construction is delayed or the proposed area experiences severe weather conditions, please contact the geotechnical engineer prior to construction. No warranties, either expressed or implied, are intended or made. In the event that changes in the nature, design, or location of the project as outlined in this report are planned, the conclusions and recommendations contained in this report shall not be considered valid unless Gessner Engineering reviews the changes and either verifies or modifies the conclusions of this report in writing.

APPENDIX

- ✓ Project Location
- ✓ Project Layout
- ✓ Logs of Borings
- ✓ Symbols and Terms
- ✓ Glossary of Geological Terms

Mobile B-37 Drill Rig: Bubba Red





GESSNER
ENGINEERING

NEW BRAUNFELS FIRE STATION NO. 7

355 FARM TO MARKET ROAD 306
NEW BRAUNFELS, TEXAS

PROJECT LOCATION

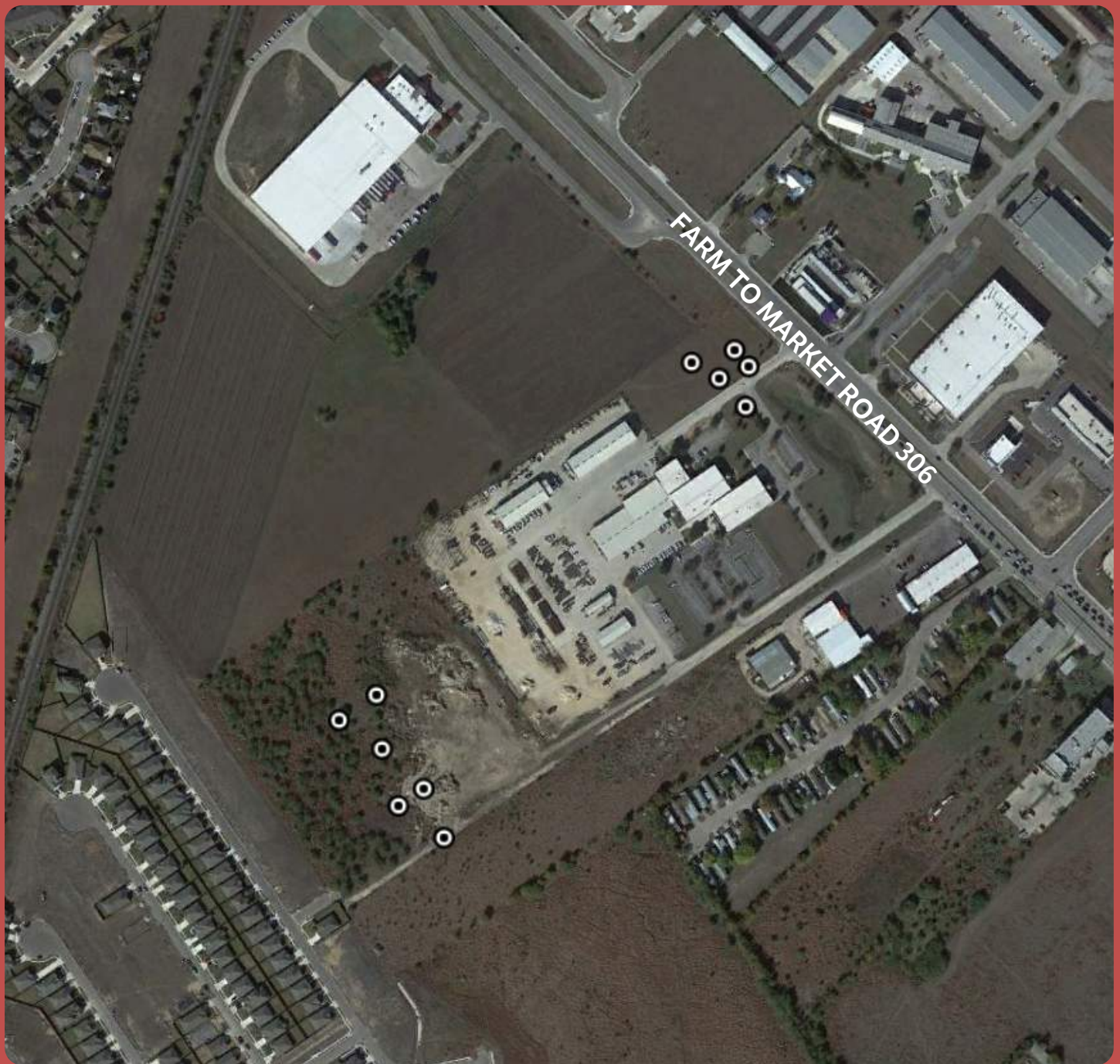
Corporate: 2501 Ashford Drive | College Station, Texas 77840
www.gessnerengineering.com | 1-877-GESSNER
College Station | Brenham | Fort Worth | Georgetown | San Antonio

TBPLS F-1093910

PLAN | DESIGN | VERIFY

TBPE F-7451

Scale: NTS
Job No. 20-0404
Drawn By: PMP
Checked By: MCF
Drawn Date: 09.17.20
Drawing No. 1



GESSNER
ENGINEERING

NEW BRAUNFELS FIRE STATION NO. 7

355 FARM TO MARKET ROAD 306
NEW BRAUNFELS, TEXAS

PROJECT LAYOUT

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TBPLS F-1093910

PLAN | DESIGN | VERIFY

TBPE F-7451

Scale: NTS

Job No. 20-0404

Drawn By: PMP

Checked By: MCF

Drawn Date: 09.17.20

Drawing No. 2



Boring	Approximate Location
BH-1	29.73371, -98.08448
BH-2	29.73349, -98.08462
BH-3	29.73358, -98.08436
PH-1	29.73361, -98.08487
PH-2	29.73327, -98.08438



GESSNER
ENGINEERING

NEW BRAUNFELS FIRE STATION NO. 7

355 FARM TO MARKET ROAD 306
NEW BRAUNFELS, TEXAS

PROJECT LAYOUT

Corporate: 2501 Ashford Drive | College Station, Texas 77840
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TBPLS F-1093910

PLAN | DESIGN | VERIFY

TBPE F-7451

Scale: NTS

Job No. 20-0404

Drawn By: PMP

Checked By: MCF

Drawn Date: 09.17.20

Drawing No. 3



Boring	Approximate Location
BH-4	29.73017, -98.08749
BH-5	29.79030, -98.08727
PH-3	29.73061, -98.08764
PH-4	29.72992, -98.08708
TH-1	29.73103, -98.08769
TH-2	29.73083, -98.08802



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NEW BRAUNFELS FIRE STATION NO. 7

355 FARM TO MARKET ROAD 306
NEW BRAUNFELS, TEXAS

PROJECT LAYOUT

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College Station | Brenham | Fort Worth | Georgetown | San Antonio

TBPLS F-1093910

PLAN | DESIGN | VERIFY

TBPE F-7451

Scale: NTS
Job No. 20-0404
Drawn By: PMP
Checked By: MCF
Drawn Date: 09.17.20
Drawing No. 4



LOG OF BORING NO: BH-1

PAGE 1 OF 1

CLIENT: Brown Reynolds Watford Achitects
PROJECT: New Braunfels Fire Station No. 7
 355 Farm to Market Road 306
 New Braunfels, Texas
PROJECT NO: 20-0404
DATE: 9/1/2020
DRILLER: Gessner Engineering

BOREHOLE LOCATION: 29.73371, -98.08448
LOCATION ON SITE: Fire Station
BOREHOLE TERMINATION DEPTH: 30 feet
INITIAL GROUNDWATER DEPTH: Not Encountered
FINAL GROUNDWATER DEPTH: Dry at Completion
GROUND COVER: Grass and Weeds
***ALL DEPTHS, ELEVATIONS, AND LOCATIONS ARE APPROXIMATE**

DEPTH (ft)	WATER LEVEL	GRAPHIC LOG	SAMPLE TYPE	PENETROMETER OR BLOW COUNT	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	FINES CONTENT (%)	UNCONFINED COMPRESSION (tsf)	USCS CLASSIFICATION	MATERIAL DESCRIPTION
0												
				4/3/3	75	47	15.7					CLAY, Stiff to Very Stiff, Brown with organics and rock fragments from 0 to 2 feet
				4/4/6			17.8					
5				5/8/14			17.3					with calcareous deposits from 4 to 5 feet
				6/9/14	30	15	12.3		69		CL	CLAY, Sandy, Very Stiff, Tan, with calcareous deposits
10				50-12"			7.0					SAND, Clayey, Very Dense, Tan, with gravel and weathered limestone
15				Ref.-3"			9.0					
20				50-8"			5.5		26			
25				50-5"			12.8					
30				50-1"			5.5					



LOG OF BORING NO: BH-2

PAGE 1 OF 1

CLIENT: Brown Reynolds Watford Achitects
PROJECT: New Braunfels Fire Station No. 7
 355 Farm to Market Road 306
 New Braunfels, Texas
PROJECT NO: 20-0404
DATE: 9/2/2020
DRILLER: Gessner Engineering

BOREHOLE LOCATION: 29.73349, -98.08462
LOCATION ON SITE: Fire Station
BOREHOLE TERMINATION DEPTH: 30 feet
INITIAL GROUNDWATER DEPTH: Not Encountered
FINAL GROUNDWATER DEPTH: Dry at Completion
GROUND COVER: Grass and Weeds
***ALL DEPTHS, ELEVATIONS, AND LOCATIONS ARE APPROXIMATE**

DEPTH (ft)	WATER LEVEL	GRAPHIC LOG	SAMPLE TYPE	PENETROMETER OR BLOW COUNT	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	FINES CONTENT (%)	UNCONFINED COMPRESSION (tsf)	USCS CLASSIFICATION	MATERIAL DESCRIPTION
0												
				5/5/7			15.5					CLAY, Stiff to Very Stiff, Brown and Tan with organics from 0 to 2 feet
				7/12/15	58	31	17.2		94		CH	
5				5/7/9			19.1					with calcareous deposits from 4 to 8 feet
				7/15/15			18.1					
10				16/25/18	28	14	10.5		22		GC	GRAVEL, Clayey, Dense to Very Dense, Tan, with sand and weathered limestone
15				50-11"			5.7					
20				50-3"			3.3					
25				Ref.-4"			4.6		25			
30				50-3"			6.0					



LOG OF BORING NO: BH-3

PAGE 1 OF 1

CLIENT: Brown Reynolds Watford Achitects
PROJECT: New Braunfels Fire Station No. 7
 355 Farm to Market Road 306
 New Braunfels, Texas
PROJECT NO: 20-0404
DATE: 9/1/2020
DRILLER: Gessner Engineering

BOREHOLE LOCATION: 29.73358, -98.08436
LOCATION ON SITE: Fire Station
BOREHOLE TERMINATION DEPTH: 30 feet
INITIAL GROUNDWATER DEPTH: Not Encountered
FINAL GROUNDWATER DEPTH: Dry at Completion
GROUND COVER: Grass and Weeds
***ALL DEPTHS, ELEVATIONS, AND LOCATIONS ARE APPROXIMATE**

DEPTH (ft)	WATER LEVEL	GRAPHIC LOG	SAMPLE TYPE	PENETROMETER OR BLOW COUNT	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	FINES CONTENT (%)	UNCONFINED COMPRESSION (tsf)	USCS CLASSIFICATION	MATERIAL DESCRIPTION
0												
				3/4/5			17.0					CLAY, Stiff to Hard, Brown and Tan with organics from 0 to 2 feet
				5/8/10	61	33	18.0					
5				6/8/10	55	32	10.5		88		CH	with calcareous deposits from 4 to 8 feet
				11/14/19			11.7					
10				50-12"	23	10	9.4		28		SC	SAND, Clayey, Dense to Very Dense, Tan, with gravel and weathered limestone
15				50-9"			9.2					
20				50-5"			11.1					
25				5/19/19			5.0					
30				50-12"			6.5					



LOG OF BORING NO: BH-5

PAGE 1 OF 1

CLIENT: Brown Reynolds Watford Achitects
PROJECT: New Braunfels Fire Station No. 7
 355 Farm to Market Road 306
 New Braunfels, Texas
PROJECT NO: 20-0404
DATE: 9/14/2020
DRILLER: Gessner Engineering

BOREHOLE LOCATION: 29.73030, -98.08727
LOCATION ON SITE: Training Classroom
BOREHOLE TERMINATION DEPTH: 30 feet
INITIAL GROUNDWATER DEPTH: Not Encountered
FINAL GROUNDWATER DEPTH: Dry at Completion
GROUND COVER: Grass and Weeds
***ALL DEPTHS, ELEVATIONS, AND LOCATIONS ARE APPROXIMATE**

DEPTH (ft)	WATER LEVEL	GRAPHIC LOG	SAMPLE TYPE	PENETROMETER OR BLOW COUNT	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	FINES CONTENT (%)	UNCONFINED COMPRESSION (tsf)	USCS CLASSIFICATION	MATERIAL DESCRIPTION
0												
5				5/6/6			12.2					FILL: GRAVEL, Clayey, Very Loose to Medium Dense, Brown and Gray, with sand
				8/6/15	41	24	13.5		46		GC	
				2/3/3			16.8					
				6/9/14			17.9					
10				3/5/7	58	34	31.2		96		CH	CLAY, Stiff, Brown
15				50-12"			6.9					SAND, Clayey, Dense to Very Dense, Tan, with gravel
20				16/14/34			13.1					
25				Ref.-5"			10.0					
30				50-10"			12.2					



LOG OF BORING NO: PH-1

PAGE 1 OF 1

CLIENT: Brown Reynolds Watford Achitects
PROJECT: New Braunfels Fire Station No. 7
355 Farm to Market Road 306
New Braunfels, Texas
PROJECT NO: 20-0404
DATE: 9/1/2020
DRILLER: Gessner Engineering

BOREHOLE LOCATION: 29.73361, -98.08487
LOCATION ON SITE: Pavement
BOREHOLE TERMINATION DEPTH: 6 feet
INITIAL GROUNDWATER DEPTH: Not Encountered
FINAL GROUNDWATER DEPTH: Dry at Completion
GROUND COVER: Grass and Weeds
***ALL DEPTHS, ELEVATIONS, AND LOCATIONS ARE APPROXIMATE**

DEPTH (ft)	WATER LEVEL	GRAPHIC LOG	SAMPLE TYPE	PENETROMETER OR BLOW COUNT	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	FINES CONTENT (%)	UNCONFINED COMPRESSION (tsf)	USCS CLASSIFICATION	MATERIAL DESCRIPTION
0												
				2/6/5			16.4					CLAY, Firm to Very Stiff, Brown and Tan with organics from 0 to 2 feet
				3/3/5	79	52	18.6		93		CH	
5				5/11/14			10.3					with calcareous deposits from 4 to 6 feet



LOG OF BORING NO: PH-2

PAGE 1 OF 1

CLIENT: Brown Reynolds Watford Achitects
PROJECT: New Braunfels Fire Station No. 7
355 Farm to Market Road 306
New Braunfels, Texas
PROJECT NO: 20-0404
DATE: 9/1/2020
DRILLER: Gessner Engineering

BOREHOLE LOCATION: 29.73327, -98.08438
LOCATION ON SITE: Pavement
BOREHOLE TERMINATION DEPTH: 6 feet
INITIAL GROUNDWATER DEPTH: Not Encountered
FINAL GROUNDWATER DEPTH: Dry at Completion
GROUND COVER: Grass and Weeds
***ALL DEPTHS, ELEVATIONS, AND LOCATIONS ARE APPROXIMATE**

DEPTH (ft)	WATER LEVEL	GRAPHIC LOG	SAMPLE TYPE	PENETROMETER OR BLOW COUNT	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	FINES CONTENT (%)	UNCONFINED COMPRESSION (tsf)	USCS CLASSIFICATION	MATERIAL DESCRIPTION
0												
				4/6/8	58	34	15.2		71		CH	CLAY, Stiff to Very Stiff, Brown with calcareous deposits from 0 to 2 feet with gravel from 0 to 4 feet
				6/10/14			18.2					
5				6/12/17	65	38	20.0		95		CH	



LOG OF BORING NO: PH-3

PAGE 1 OF 1

CLIENT: Brown Reynolds Watford Achitects
PROJECT: New Braunfels Fire Station No. 7
355 Farm to Market Road 306
New Braunfels, Texas
PROJECT NO: 20-0404
DATE: 9/14/2020
DRILLER: Gessner Engineering

BOREHOLE LOCATION: 29.73061, -98.08764
LOCATION ON SITE: Pavement
BOREHOLE TERMINATION DEPTH: 6 feet
INITIAL GROUNDWATER DEPTH: Not Encountered
FINAL GROUNDWATER DEPTH: Dry at Completion
GROUND COVER: Grass and Weeds
***ALL DEPTHS, ELEVATIONS, AND LOCATIONS ARE APPROXIMATE**

DEPTH (ft)	WATER LEVEL	GRAPHIC LOG	SAMPLE TYPE	PENETROMETER OR BLOW COUNT	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	FINES CONTENT (%)	UNCONFINED COMPRESSION (tsf)	USCS CLASSIFICATION	MATERIAL DESCRIPTION
0												
				5/5/7	47	28	11.7		52		CL	CLAY, Gravelly, Stiff, Tan, with sand and organics
				6/8/7			22.0					CLAY, Stiff to Very Stiff, Brown
5				4/7/9	70	41	27.5		75		CH	with calcareous deposits from 4 to 6 feet



LOG OF BORING NO: PH-4

PAGE 1 OF 1

CLIENT: Brown Reynolds Watford Achitects
PROJECT: New Braunfels Fire Station No. 7
355 Farm to Market Road 306
New Braunfels, Texas
PROJECT NO: 20-0404
DATE: 9/14/2020
DRILLER: Gessner Engineering

BOREHOLE LOCATION: 29.72992, -98.08708
LOCATION ON SITE: Pavement
BOREHOLE TERMINATION DEPTH: 6 feet
INITIAL GROUNDWATER DEPTH: Not Encountered
FINAL GROUNDWATER DEPTH: Dry at Completion
GROUND COVER: Grass and Weeds
***ALL DEPTHS, ELEVATIONS, AND LOCATIONS ARE APPROXIMATE**

DEPTH (ft)	WATER LEVEL	GRAPHIC LOG	SAMPLE TYPE	PENETROMETER OR BLOW COUNT	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	FINES CONTENT (%)	UNCONFINED COMPRESSION (tsf)	USCS CLASSIFICATION	MATERIAL DESCRIPTION
0												
				12/18/10			11.6					CLAY, Gravelly, Very Stiff, Brown, with sand
				5/9/14	89	65	19.7		91		CH	CLAY, Very Stiff, Brown, with calcareous deposits
5				4/7/9			25.3					



LOG OF BORING NO: TH-1

PAGE 1 OF 2

CLIENT: Brown Reynolds Watford Achitects
PROJECT: New Braunfels Fire Station No. 7
 355 Farm to Market Road 306
 New Braunfels, Texas
PROJECT NO: 20-0404
DATE: 9/8/2020
DRILLER: Gessner Engineering

BOREHOLE LOCATION: 29.73103, -98.08769
LOCATION ON SITE: Burn Tower 1
BOREHOLE TERMINATION DEPTH: 50 feet
INITIAL GROUNDWATER DEPTH: Not Encountered
FINAL GROUNDWATER DEPTH: Dry at Completion
GROUND COVER: Grass and Weeds
***ALL DEPTHS, ELEVATIONS, AND LOCATIONS ARE APPROXIMATE**

DEPTH (ft)	WATER LEVEL	GRAPHIC LOG	SAMPLE TYPE	PENETROMETER OR BLOW COUNT	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	FINES CONTENT (%)	UNCONFINED COMPRESSION (tsf)	USCS CLASSIFICATION	MATERIAL DESCRIPTION
0												
				9/12/14			12.3					GRAVEL, Clayey, Medium Dense, Brown, with weathered limestone
				3/4/7	44	27	8.8		26		GC	
5				2/4/16			30.2					CLAY, Very Stiff, Brown and Tan
				18/20/29	65	38	11.6		19		GC	GRAVEL, Clayey, Medium Dense to Very Dense, Tan, with sand
10				50-5"			20.1					
15				7/7/6			8.0		34			
20				Ref.-5"			3.1					
25				50-3"			2.6		18			
30				50-3"			2.8					
35				Ref.-5"			4.7					

(Continued Next Page)



LOG OF BORING NO: TH-1

PAGE 2 OF 2

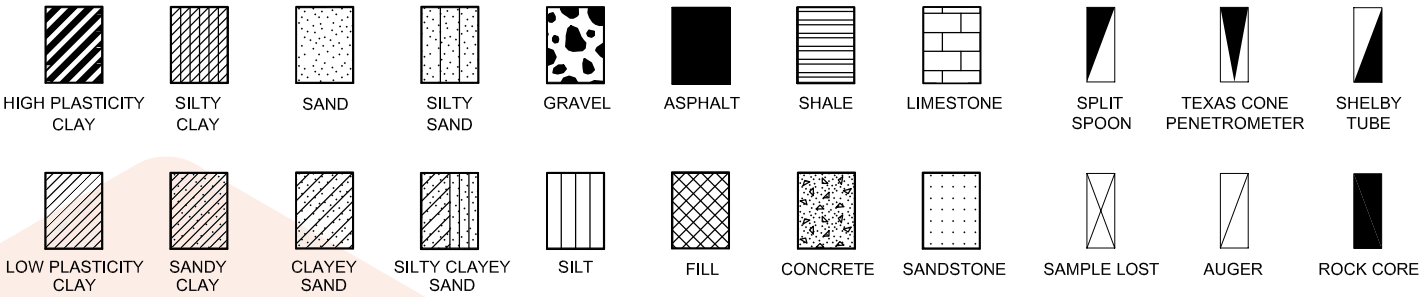
CLIENT: Brown Reynolds Watford Achitects
PROJECT NO: 20-0404

PROJECT NAME: New Braunfels Fire Station No. 7
355 Farm to Market Road 306
New Braunfels, Texas

DEPTH (ft)	WATER LEVEL	GRAPHIC LOG	SAMPLE TYPE	PENETROMETER OR BLOW COUNT	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	FINES CONTENT (%)	UNCONFINED COMPRESSION (tsf)	USCS CLASSIFICATION	MATERIAL DESCRIPTION
35												GRAVEL, Clayey, Medium Dense to Very Dense, Tan, with sand (continued)
40				18/14/23	34	18	32.7		67		CL	CLAY, Sandy, Hard, Tan
45				15/21/24			24.0					
50				Ref.-5"			8.2		15			GRAVEL, Clayey, Very Dense, Tan

SYMBOLS AND TERMS USED ON BORING LOGS

SOIL SYMBOLS AND DESCRIPTION



SAMPLER TYPES

GROUNDWATER SYMBOLS AND DESCRIPTION

- GROUNDWATER ENCOUNTERED DURING DRILLING
 - GROUNDWATER DEPTH UPON DRILLING COMPLETION

TERMS DESCRIBING CONSISTENCY OR CONDITION

COARSE GRAINED SOILS (Major Portion Retained on No. 200 Sieve): Includes (1) clean gravels and sands and (2) silty or clayey gravels and sands. Condition is rated according to relative density, as determined by laboratory tests.

Standard Penetration,
N-Value, blows/ft

0-4
4-10
10-30
30-50
>50

Relative Density

Very Loose
Loose
Medium Dense
Dense
Very Dense

FINE GRAINED SOILS (Major Portion Passing No. 200 Sieve): Includes (1) inorganic and organic silts and clays; (2) gravelly, sandy, or silty clays; and (3) clayey silts. Consistency is rated according to shearing strength, as indicated by penetrometer readings or by unconfined compression tests.

Standard Penetration,
N-Value, blows/ft

0-2
2-4
4-8
8-15
15-30
>30

Pocket Penetrometer

Reading

0-0.25
0.25-0.5
0.5-1.0
1.0-2.0
2.0-4.0
>4.0

Consistency

Very Soft
Soft
Firm
Stiff
Very Stiff
Hard

Cohesive Strength, tons/sf

less than 0.125
0.125 to 0.25
0.25 to 0.50
0.50 to 1.00
1.00 to 2.00
2.00 and higher

Note: Slickensided and fissured clays may have lower unconfined compressive strengths than shown above due to planes of weakness or cracks in the soil.

EXPANSION POTENTIAL OF COHESIVE SOILS

Plasticity Index

0-5
5-10
10-20
20-40
>40

Degree of Expansive Potential

Nonplastic
Low
Moderate
High
Very High

ROCK QUALITY DESIGNATION

RQD=Rock Quality Designation

The percentage of intact rock retrieved from a bore hole. All pieces of intact rock core equal to or greater than 4 inches long are summed and divided by the total length of the core run.

REC = Recovery

This is the total percentage of material recovered from a run.

TERMS CHARACTERIZING SOIL STRUCTURE

Slickensided	- having inclined planes of weakness that are slick and glossy in appearance
Fissured	- containing shrinkage cracks, frequently filled with fine sand or silt; usually more or less vertical
Laminated	- composed of thin layers of varying color and texture
Interbedded	- composed of alternate layers of different soil types
Calcareous	- containing appreciable quantities of calcium carbonate
Well graded	- having wide range in grain sizes and substantial amounts of all intermediate particle sizes
Poorly graded	- predominantly of one grain size, or having a range of sizes with some intermediate size missing
Flocculated	- pertaining to cohesive silts that exhibit a loose knit or flakey structure

GLOSSARY OF GEOLOGIC TERMS

Aphanitic	- dense, homogeneous rock with constituents so fine that they cannot be seen by the naked eye
Argillaceous	- containing, made of, or resembling clay; clayey
Bentonitic	- an absorbent aluminum silicate clay formed from volcanic ash and used in various adhesives, cements, and ceramic fillers
Carbonaceous	- consisting of, containing, relating to, or yielding carbon
Chert	- a siliceous rock of chalcedonic or opaline silica occurring in limestone
Conchoidal	- of, relating to, or being a surface characterized by smooth, shell-like convexities and concavities, as on fractured obsidian
Crossbedded	- intersecting layers of distinct soil deposits
Fluviatile	- produced by the action of a river or stream
Fossiliferous	- containing fossils
Friable	- readily crumbled, brittle
Glauconitic	- a greenish mineral of the mica group, a hydrous silicate of potassium, iron, aluminum, or magnesium found in <i>greensand</i> and used as a fertilizer and water softener
Gypsiferous	- containing gypsum; a widespread colorless, white, or yellowish mineral, used in the manufacture of various plaster products, and fertilizers
Igneous	- rocks formed by solidification from a molten state; pyrogenic
Inclusion	- a solid, liquid, or gaseous foreign body enclosed in a mineral or rock.
Indurated	- hardened soil that has been changed by extreme climate
Laminated	- a soil deposit divided into thin layers
Lateritic	- pertaining to red residual soil in humid tropical and subtropical regions that is leached of soluble minerals, aluminum hydroxides, and silica but still contains concentrations of iron oxides and iron hydroxides.
Lenticular	- lens-shaped grains of soil or rock
Lignitic	- pertaining to soft, brownish-black coal in which the alteration of vegetable matter has proceeded further than in peat but not as far as in bituminous coal; also called <i>brown coal</i>
Marl	- a loose and crumbling earthy deposit consisting mainly of calcite or dolomite; used as a fertilizer for soils deficient in lime
Metamorphic	- rocks changed in structure or composition as a result of metamorphism caused by chemical reaction or heat and pressure
Micaceous	- containing mica; any of a group of chemically and physically related aluminum silicate minerals, common in igneous and metamorphic rocks, characteristically splitting into flexible sheets used in insulation and electrical equipment
Montmorillonitic	- clays that are comprised mostly of montmorillonite; one of the three types of clay soil grains (illite, kaolinite, and montmorillonite)
Morphology	- refers to the geological characteristics, configuration, and evolution of rocks and landforms
Porous	- admitting the passage of gas or liquid through pores or interstices
Pyrite	- a brass-colored mineral occurring widely and used as an iron ore and in producing sulfur dioxide for sulfuric acid; also called <i>fool's gold</i>
Scarp	- a long steep slope or cliff at the edge of a plateau or ridge; usually formed by erosion
Siliceous	- containing, resembling, relating to, or consisting of silica; a white or colorless crystalline compound occurring abundantly as quartz, sand, flint, agate, and many other minerals and used to manufacture a wide variety of materials, especially glass and concrete
Surficial	- of, relating to, or occurring on or near the surface of the earth
Tuffaceous	- comprising rocks made of compacted volcanic ash varying in size from fine sand to coarse gravel; also called <i>tufa</i>

SECTION 01 10 00 - SUMMARY

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Project information.
 - 2. Work covered by Contract Documents.
 - 3. Contractor's Duties.
 - 4. Procedures for requesting additional time due to Weather Delays.
 - 5. Prevailing Wage Rates.
 - 6. Work by Owner.
 - 7. Owner-furnished products.
 - 8. Access to site.
 - 9. Coordination with occupants.
 - 10. Work restrictions.
 - 11. Specification and drawing conventions.
 - 12. Indemnity and Disclaimer.
- B. Related Requirements:
 - 1. Division 01 Section - Temporary Facilities and Controls for limitations and procedures governing temporary use of Owner's facilities.

1.03 PROJECT INFORMATION

- A. Project Identification: New Braunfels Fire Training Complex. BRW Project No. 219065.00
 - 1. Project Location: 353 Hwy 306 New Braunfels, Texas 78130
- B. Owner: City of New Braunfels
 - 1. Owner's Representative: Adam Michie, PE, Capital Project Manager, Telephone: (830) 221-4079. Email: AMiche@nbtexas.org
- C. Architect: Brown Reynolds Watford Architects, Inc., 175 Century Square Drive, Suite 350 College Station, Texas 77840 Telephone: (979) 694-1791
- D. Architect's Consultants: The Architect has retained the following design professionals who have prepared designated portions of the Contract Documents:
 - 1. Civil / Structural Engineer: Gessner Engineering, 2501 Ashford Drive, Suite 102 College Station, Texas 77840 Telephone: (979) 680-8840
 - 2. MEP Engineer: Dawson Van Orden Engineering, 100 Commons Road, Suite 11 Dripping Springs, Texas 78620 Telephone: (281) 293-7500

1.04 CONTRACTOR'S DUTIES

- A. Furnish & provide for proper execution and completion of work as required by the Contract Documents all:
 - 1. Labor, materials and equipment.
 - 2. Tools, construction equipment and machinery.
 - 3. Water, heat and utilities required for construction.
 - 4. Other facilities and services necessary for proper execution and completion of the work.
- B. Attain and pay for all required permits, licenses, and government fees.

1. Unless specifically indicated otherwise, Contractor is responsible to hire and pay for all third party reviews and inspections required by authorities having jurisdiction.
 - a. Owner will retain and Owner will pay for handicap accessibility inspection required by TDLR. Coordinate scheduling with Architect to coincide with or to follow after substantial completion.
- C. Give required notices.
- D. Comply with codes, ordinances, rules, regulations, orders and other legal requirements of public authorities which bear on performance of work.
- E. Promptly submit written notice to Architect of observed variance of Contract Documents from legal requirements. It is not Contractor's responsibility to make certain that drawings and specifications comply with codes and regulations.
- F. Contractor shall verify all conditions at the site and dimensions in the field prior to starting work. Architect shall be notified in writing of any discrepancies found.
- G. The Drawing and Specifications represent the work to be completed not the method of construction. However, the Contractor shall perform all demolition and remedial work in a sequence to where any interruption of the operation of the facilities or utility service occurs at an absolute minimum.
- H. Contractor shall use every precaution to prevent damage to roads, landscape, adjacent property, building and utilities above and below ground that are adjacent to or included in the area under contract. The Contractor shall repair and replace, at his expense, any material or building affected, damaged or destroyed because of his operations or work.
- I. Safety Requirements: The CONTRACTOR has full responsibility for the safety of workers and for all damages to personal property caused by its operations. The CONTRACTOR is responsible for following all Federal, State, and Local Regulations and Guidelines with regards to worker and public safety. Unless otherwise indicated on the proposal, the necessary tools, equipment, procedures, etc. for following the appropriate regulations and guidelines will be considered subsidiary to other proposal items.

1.05 WEATHER DAYS

- A. The Contractor may be granted an extension of time because of abnormal inclement weather conditions. Contractor shall submit reports on monthly intervals indicating the rainfall and temperature on inclement weather days to document for each month the days in excess of normal inclement weather conditions that may contribute to future time extension requests.
 1. Provide reports each month whether or not Contractor believes at that time that time extension will be necessary. In months not exceeding normal inclement weather days and for which additional time will not be requested, reports need not be provided.
 2. Available float shall be used before any request is made for time extension due to inclement weather.
- B. For the purpose of this contract, "abnormal inclement weather" will be interpreted as those days in excess of the number of days shown in the table below. Drying days shall also be interpreted as "abnormal inclement weather" days.
- C. The following schedule of monthly anticipated adverse weather delays is based on National Oceanic and Atmospheric Administration (NOAA) or similar data for the Project location and will constitute the base line for monthly weather time evaluations:

MONTHLY ANTICIPATED ADVERSE WEATHER DELAY WORK DAYS BASED ON FIVE (5) DAY WORK WEEK

JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
(4)	(4)	(4)	(3)	(5)	(6)	(4)	(3)	(4)	(4)	(4)	(4)

- D. All claims for additional time shall be limited to time extensions only. Claims for additional costs due to time extensions for weather shall not be considered.

1.06 PREVAILING WAGE REQUIREMENTS

- A. The CONTRACTOR shall comply in all respects with all requirements imposed by any laws, ordinances or resolutions applicable to the Project with regard to the minimum prevailing wage rates for all classes of employees, laborers, subcontractors, mechanics, workmen and persons furnishing labor and services to the Project. The City of New Braunfels has adopted the Prevailing Wage Rate Schedule, bound into the project manual, which specifies the classes and wage rates to be paid to all persons as defined therein. The CONTRACTOR shall pay not less than the minimum wage rates established thereby for each class, craft, or type of labor, workman, or mechanic employed in the execution of this Contract. Upon request by the Owner, CONTRACTOR shall make available for inspection and copying its books and records, including but not limited to its payroll records, account information and other documents as may be required by the Owner to insure compliance with this provision.

1.07 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of Project is defined by the Contract Documents and consists of the following:
1. Work of the project is for all labor, supervision, materials, services and equipment required in conjunction with all work to construct drainage improvements, concrete paving, site work including clearing, grading, utilities to future buildings, landscaping, and irrigation.
- B. Type of Contract:
1. Project will be constructed under a single prime contract.

1.08 WORK BY OWNER

- A. General: Cooperate fully with Owner so work may be carried out smoothly, without interfering with or delaying work under this Contract or work by Owner. Coordinate the Work of this Contract with work performed by Owner.
- B. Preceding Work: Owner will perform the following construction operations at Project site. Those operations are scheduled to be substantially complete before work under this Contract begins.
1. Relocation of furnishings and other Owner's items prior to demolition start, will be performed by Owner's personnel or under separate contract prior to demolition start. Coordinate scheduling of these activities with Owner.
- C. Concurrent Work: Owner will perform the following construction operations at Project site. Those operations will be conducted simultaneously with work under this Contract.
1. Telecommunications wiring and equipment installation, including voice, data, and cable TV.
 2. Audio Visual wiring and equipment installation.
 3. Door Access Control wiring and equipment installation.
 4. Security Camera System wiring and equipment installation.
 5. Radio Communications System wiring and equipment installation.
 6. Fire Station Alerting System.

- D. Subsequent Work: Owner will perform the following additional work at site after Substantial Completion. Completion of that work will depend on successful completion of preparatory work under this Contract.

1. Furniture, fixturing and equipment installation.

1.09 ACCESS TO SITE

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

1.10 COORDINATION WITH OCCUPANTS

- A. Owner Limited Occupancy of Completed Areas of Construction: Owner reserves the right to occupy and to place and install equipment in completed portions of the Work, prior to Substantial Completion of the Work, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and limited occupancy shall not constitute acceptance of the total Work.
1. Architect will prepare a Certificate of Substantial Completion for each specific portion of the Work to be occupied prior to Owner acceptance of the completed Work.
 2. Obtain a Certificate of Occupancy from authorities having jurisdiction before limited Owner occupancy.
 3. Before limited Owner occupancy, mechanical and electrical systems shall be fully operational, and required tests and inspections shall be successfully completed. On occupancy, Owner will operate and maintain mechanical and electrical systems serving occupied portions of Work.
 4. On occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of Work.

1.11 WORK RESTRICTIONS

- A. Work Restrictions, General: Comply with restrictions on construction operations.
1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.
 2. Comply with work hour and noise restriction requirements of local authorities, if such exist.
- B. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:
1. Notify Architect and Owner not less than two days in advance of proposed utility interruptions.
- C. Nonsmoking Building: Smoking is not permitted within the building or within 25 feet of entrances, operable windows, or outdoor-air intakes.

1.12 SPECIFICATION AND DRAWING CONVENTIONS

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

- B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.
- C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
 - 1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
 - 2. Abbreviations: Materials and products are identified by abbreviations scheduled on Drawings.
 - 3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

1.13 INDEMNITY AND DISCLAIMER

- A. OWNER SHALL NOT BE LIABLE OR RESPONSIBLE FOR, AND SHALL BE INDEMNIFIED, DEFENDED, HELD HARMLESS AND RELEASED BY CONTRACTOR FROM AND AGAINST ANY AND ALL SUITS, ACTIONS, LOSSES, DAMAGES, CLAIMS, OR LIABILITY OF ANY CHARACTER, TYPE, OR DESCRIPTION, INCLUDING ALL EXPENSES OF LITIGATION, COURT COSTS, AND ATTORNEY'S FEES FOR INJURY OR DEATH TO ANY PERSON, OR INJURY OR LOSS TO ANY PROPERTY, RECEIVED OR SUSTAINED BY ANY PERSON OR PERSONS, INCLUDING THE CONTRACTOR, AND ITS EMPLOYEES, OR PROPERTY ARISING OUT OF, OR OCCASIONED BY, DIRECTLY OR INDIRECTLY, THE PERFORMANCE OF CONTRACTOR UNDER THIS AGREEMENT, REGARDLESS OF WHETHER THE OWNER'S OR OWNER'S AGENTS, REPRESENTATIVES, EMPLOYEES, ENGINEERS OR ARCHITECTS CONDUCT, NEGLIGENCE OR FAULT CONTRIBUTED TO SUCH INJURY, DEATH OR LOSS, WITHOUT, HOWEVER, WAIVING ANY GOVERNMENTAL IMMUNITY AVAILABLE TO THE OWNER UNDER TEXAS LAW AND WITHOUT WAIVING ANY DEFENSES OF THE PARTIES UNDER TEXAS LAW. THE PROVISIONS OF THIS INDEMNIFICATION ARE SOLELY FOR THE BENEFIT OF THE PARTIES HERETO AND NOT INTENDED TO CREATE OR GRANT ANY RIGHTS, CONTRACTUAL OR OTHERWISE, TO ANY OTHER PERSON OR ENTITY. IT IS THE EXPRESSED INTENT OF THE PARTIES TO THIS AGREEMENT THAT THE INDEMNITY EXTENDED BY CONTRACTOR TO INDEMNIFY AND PROTECT OWNER FROM THE CONSEQUENCES OF THE CONTRACTOR'S AS WELL AS THE OWNER'S NEGLIGENCE, WHETHER SUCH NEGLIGENCE IS THE SOLE OR PARTIAL CAUSE OF ANY SUCH INJURY, DEATH, OR DAMAGE.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

END OF SECTION 01 10 00

SECTION 01 21 00 - ALLOWANCES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section includes administrative and procedural requirements governing allowances.
 - 1. Certain items are specified in the Contract Documents by allowances. Allowances have been established in lieu of additional requirements and to defer selection of actual materials and equipment to a later date when direction will be provided to Contractor. If necessary, additional requirements will be issued by Change Order.
- B. Types of allowances include the following:
 - 1. Contingency allowances.
- C. Related Requirements:
 - 1. Division 01 Section - Unit Prices for procedures for using unit prices.
 - 2. Division 01 Section - Quality Requirements for procedures governing the use of allowances for testing and inspecting.
 - 3. Divisions 02 through 48 Sections for items of Work covered by allowances.

1.03 SELECTION AND PURCHASE

- A. At the earliest practical date after award of the Contract, advise Architect of the date when final selection and purchase of each product or system described by an allowance must be completed to avoid delaying the Work.
- B. At Architect's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.
- C. Purchase products and systems selected by Architect from the designated supplier.

1.04 ACTION SUBMITTALS

- A. Submit proposals for purchase of products or systems included in allowances, in the form specified for Change Orders.

1.05 INFORMATIONAL SUBMITTALS

- A. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.
- B. Submit time sheets and other documentation to show labor time and cost for installation of allowance items that include installation as part of the allowance.
- C. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

1.06 COORDINATION

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

1.07 CONTINGENCY ALLOWANCES

- A. Use the contingency allowance only as directed by Architect for Owner's purposes and only by Change Orders that indicate amounts to be charged to the allowance.
- B. Contractor's overhead, profit, and related costs for products and equipment ordered by Owner under the contingency allowance are included in the allowance and are not part of the Contract Sum. These costs include delivery, installation, insurance, equipment rental, and similar costs.
- C. Change Orders authorizing use of funds from the contingency allowance will include Contractor's related costs and reasonable overhead and profit margins.
- D. At Project closeout, credit unused amounts remaining in the contingency allowance to Owner by Change Order.

1.08 ADJUSTMENT OF ALLOWANCES

- A. Allowance Adjustment: To adjust allowance amounts, prepare a Change Order proposal based on the difference between purchase amount and the allowance, multiplied by final measurement of work-in-place where applicable. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, and similar margins.
 - 1. Include installation costs in purchase amount only where indicated as part of the allowance.
 - 2. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other margins claimed.
 - 3. Submit substantiation of a change in scope of work, if any, claimed in Change Orders related to unit-cost allowances.
 - 4. Owner reserves the right to establish the quantity of work-in-place by independent quantity survey, measure, or count.
- B. Submit claims for increased costs because of a change in scope or nature of the allowance described in the Contract Documents, whether for the purchase order amount or Contractor's handling, labor, installation, overhead, and profit.
 - 1. Do not include Contractor's or subcontractor's indirect expense in the Change Order cost amount unless it is clearly shown that the nature or extent of work has changed from what could have been foreseen from information in the Contract Documents.
 - 2. No change to Contractor's indirect expense is permitted for selection of higher- or lower-priced materials or systems of the same scope and nature as originally indicated.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.01 EXAMINATION

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

3.02 PREPARATION

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

3.03 SCHEDULE OF ALLOWANCES

- A. Allowance No. 1: Contingency Allowance: For use according to Owner's written instructions. An amount for this allowance will be determined after the bidding process.

END OF SECTION 01 21 00

SECTION 01 23 00 - ALTERNATES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

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

1.03 DEFINITIONS

- A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.
 - 1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
 - 2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.
 - 3. Alternate Bids shall include all overhead and profit applicable to that portion of the work.
 - 4. The description below for each Alternate Bid is recognized to be incomplete and abbreviated, but implies that each change must be complete for the scope of work affected. The descriptions are primarily scope definitions, and do not necessarily detail the full range of materials and processes needed to complete the work as required. Refer to applicable Specification Sections, and to applicable drawings, for the specific requirements of the work, regardless of whether references are so noted in the description of each Alternate. Coordinate related work and modify surrounding work as required to properly integrate with the work of each Alternate. Any change of details, construction, etc., as required to accommodate the Alternate shall be the responsibility of the Contractor and shall be included in his Alternate Bid Price.
 - 5. Where methods of construction, materials, finishes, or details of installation, required by the various Alternate Bids, differ from the requirements shown on drawings or specified for corresponding items, the Alternate construction, materials, etc., will be subject to approval by the Architect.
 - 6. Approval of the Alternate makes all requirements of scope, performance, submissions, service and guarantee binding as any other material name appearing in the Specifications for the Base Bid. All necessary changes in building design or construction to accommodate the alternate materials shall be the sole responsibility of the Contractor without extra cost to the Owner.

1.04 PROCEDURES

- A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.
 - 1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.
 - 2. Prior to installation of the Alternate items, verify that all surfaces have been modified as necessary to accept the installation and that the item or items may be installed in

complete accordance with their manufacturer's current recommendations. Notify the Architect of any discrepancies before proceeding.

- B. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated revisions to alternates.
- C. Execute accepted alternates under the same conditions as other work of the Contract.
- D. Schedule: A schedule of alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.01 SCHEDULE OF ALTERNATES FOR TRAINING CLASSROOM BUILDING

- A. Deduct Alternate No. 1: Delete 2,000 gallon propane tank from the scope of work (RE: AS1.2)
 - 1. Pavement and bollards to remain
- B. Deduct Alternate No. 2: Remove the 35,500 sq ft of driving course paving at the north end of the site from scope of work (RE:1/AS1.4)
 - 1. Stripe driving course as seen on drawing 1/AS1.4 in lieu of layout seen on 1/AS1.2.
- C. Deduct Alternate No. 3: Delete new 12" stormwater lift station dual pump configuration (RE: C5.1, C5.2, & C10.2)
 - 1. Existing lift station and pumps to remain
- D. Deduct Alternate No. 4: Delete new stormwater lift station 17'-4" outside diameter reinforced concrete wet well (RE: C5.1, C5.2, & C10.2)
 - 1. Existing lift station and pumps to remain
- E. Deduct Alternate No. 5: Delete 321 LF of 16" Ductile Iron Pipe (RE: C5.1 & C5.2)
 - 1. Begin running ductile iron pipe at heavy line as shown on C5.2
- F. Deduct Alternate No. 6: Delete generator and electrical conduit providing emergency power for stormwater lift station (RE: MEP2.0 and MEP 2.1)
 - 1. Delete associated electrical infrastructure, underground conduits, and natural gas service indicated on sheets MEP 2.0 and MEP 2.1.
 - 2. Generator located behind existing facility as shown on sheets MEP2.0 and MEP 2.1.

END OF SECTION 01 23 00

SECTION 01 25 00 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.
- B. Related Requirements:
 - 1. Division 01 Section - Allowances for products selected under an allowance.
 - 2. Division 01 Section - Alternates for products selected under an alternate.
 - 3. Division 01 Section - Product Requirements for requirements for submitting comparable product submittals for products by listed manufacturers.
 - 4. Divisions 02 through 33 Sections for specific requirements and limitations for substitutions.

1.03 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
 - 1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
 - 2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.

1.04 ACTION SUBMITTALS

- A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Substitution Request Form: Use form acceptable to Architect.
 - 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.
 - b. Coordination information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
 - c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
 - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 - e. Samples, where applicable or requested.
 - f. Certificates and qualification data, where applicable or requested.

- g. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
 - h. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
 - i. Research reports evidencing compliance with building code in effect for Project.
 - j. Detailed comparison of Contractor's construction schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
 - k. Cost information, including a proposal of change, if any, in the Contract Sum.
 - l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents except as indicated in substitution request, is compatible with related materials, and is appropriate for applications indicated.
 - m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
- a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
 - b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.05 QUALITY ASSURANCE

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

1.06 PROCEDURES

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

PART 2 - PRODUCTS

2.01 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.
 - 1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
 - a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - b. Substitution request is fully documented and properly submitted.
 - c. Requested substitution will not adversely affect Contractor's construction schedule.

- d. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - e. Requested substitution is compatible with other portions of the Work.
 - f. Requested substitution has been coordinated with other portions of the Work.
 - g. Requested substitution provides specified warranty.
 - h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.
- B. Substitutions for Convenience: Architect will consider requests for substitution if received within 30 days after the Notice of Award. Requests received after that time may be considered or rejected at discretion of Architect.
1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
- a. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
 - b. Requested substitution does not require extensive revisions to the Contract Documents.
 - c. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - d. Substitution request is fully documented and properly submitted.
 - e. Requested substitution will not adversely affect Contractor's construction schedule.
 - f. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - g. Requested substitution is compatible with other portions of the Work.
 - h. Requested substitution has been coordinated with other portions of the Work.
 - i. Requested substitution provides specified warranty.
 - j. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

PART 3 - EXECUTION

Not Used.

END OF SECTION 01 25 00



SUBSTITUTION REQUEST (After the Bidding Phase)

Project: _____ Substitution Request Number: _____

From: _____
To: _____ Date: _____

A/E Project Number: _____
Re: _____ Contract For: _____

Specification Title: _____ Description: _____
Section: _____ Page: _____ Article/Paragraph: _____

Proposed Substitution: _____
Manufacturer: _____ Address: _____ Phone: _____
Trade Name: _____ Model No.: _____
Installer: _____ Address: _____ Phone: _____
History: ☐ New product ☐ 2-5 years old ☐ 5-10 yrs old ☐ More than 10 years old

Differences between proposed substitution and specified product: _____

☐ Point-by-point comparative data attached - REQUIRED BY A/E

Reason for not providing specified item: _____

Similar Installation:

Project: _____ Architect: _____
Address: _____ Owner: _____
_____ Date Installed: _____

Proposed substitution affects other parts of Work: ☐ No ☐ Yes; explain _____

Savings to Owner for accepting substitution: _____ (\$ _____).

Proposed substitution changes Contract Time: ☐ No ☐ Yes [Add] [Deduct] _____ days.

Supporting Data Attached: ☐ Drawings ☐ Product Data ☐ Samples ☐ Tests ☐ Reports ☐ _____

SUBSTITUTION REQUEST (Continued)

The Undersigned certifies:

- Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
- Same warranty will be furnished for proposed substitution as for specified product.
- Same maintenance service and source of replacement parts, as applicable, is available.
- Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule.
- Cost data as stated above is complete. Claims for additional costs related to accepted substitution which may subsequently become apparent are to be waived.
- Proposed substitution does not affect dimensions and functional clearances.
- Payment will be made for changes to building design, including A/E design, detailing, and construction costs caused by the substitution.
- Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.

Submitted by: _____

Signed by: _____

Firm: _____

Address: _____

Telephone: _____

Attachments: _____

A/E's REVIEW AND ACTION

- ☐ Substitution approved - Make submittals in accordance with Specification Section 01330.
- ☐ Substitution approved as noted - Make submittals in accordance with Specification Section 01330.
- ☐ Substitution rejected - Use specified materials.
- ☐ Substitution Request received too late - Use specified materials.

Signed by: _____

Date: _____

Additional Comments: ☐ Contractor ☐ Subcontractor ☐ Supplier ☐ Manufacturer ☐ A/E ☐ _____

SECTION 01 26 00 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section includes administrative and procedural requirements for handling and processing Contract modifications.
- B. Related Requirements:
 - 1. Division 01 Section - Substitution Procedures for administrative procedures for handling requests for substitutions made after the Contract award.

1.03 MINOR CHANGES IN THE WORK

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

1.04 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
 - 1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
 - 2. Within 20 days, when not otherwise specified, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
 - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - c. Include costs of labor and supervision directly attributable to the change.
 - d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
 - e. Quotation Form: Use AIA Document G709 for Proposal Requests.
- B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.
 - 1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
 - 2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.

3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Comply with requirements in Division 01 Section "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
7. Proposal Request Form: Use AIA Document G709 for Proposal Requests.

1.05 ADMINISTRATIVE CHANGE ORDERS

- A. Allowance Adjustment: See Division 01 Section "Allowances" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect actual costs of allowances.

1.06 CHANGE ORDER PROCEDURES

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

1.07 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
 1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.
- B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
 1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

END OF SECTION 01 26 00

SECTION 01 29 00 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.
- B. Related Requirements:
 - 1. Division 01 Section - Allowances for procedural requirements governing the handling and processing of allowances.
 - 2. Division 01 Section - Contract Modification Procedures for administrative procedures for handling changes to the Contract.
 - 3. Division 01 Section - Construction Progress Documentation for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.

1.03 DEFINITIONS

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

1.04 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.
 - 1. Coordinate line items in the schedule of values with other required administrative forms and schedules, including the following:
 - a. Application for Payment forms with continuation sheets.
 - b. Submittal schedule.
 - c. Items required to be indicated as separate activities in Contractor's construction schedule.
 - 2. Submit the schedule of values to Architect at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
- B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
 - 1. Identification: Include the following Project identification on the schedule of values:
 - a. Project name and location.
 - b. Name of Architect.
 - c. Architect's project number.
 - d. Contractor's name and address.
 - e. Date of submittal.
 - 2. Arrange schedule of values consistent with format of AIA Document G703.
 - 3. Arrange the schedule of values in tabular form with separate columns to indicate the following for each item listed:
 - a. Related Specification Section or Division.
 - b. Description of the Work.
 - c. Name of subcontractor.

- d. Name of manufacturer or fabricator.
- e. Name of supplier.
- f. Change Orders (numbers) that affect value.
- g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.
 - 1) Labor.
 - 2) Materials.
 - 3) Equipment.
- 4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with Project Manual table of contents. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.
- 5. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
- 6. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
 - a. Differentiate between items stored on-site and items stored off-site. If required, include evidence of insurance.
- 7. Provide separate line items in the schedule of values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
- 8. Allowances: Provide a separate line item in the schedule of values for each allowance.
- 9. Each item in the schedule of values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
 - a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the schedule of values or distributed as general overhead expense, at Contractor's option.
- 10. Schedule Updating: Update and resubmit the schedule of values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.05 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.
 - 1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.
- B. Payment Application Times: Submit Application for Payment to Architect by the last day of the month. The period covered by each Application for Payment is one month, ending on the last day of the month.
 - 1. Submit draft copy of Application for Payment seven days prior to due date for review by Architect.
- C. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.
- D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
 - 1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
 - 2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.

3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
 4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.
- E. **Stored Materials:** Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.
1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment, for stored materials.
 2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
 3. Provide summary documentation for stored materials indicating the following:
 - a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
 - b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
 - c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.
- F. **Transmittal:** Submit three signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.
1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
 2. If approved by Owner, submit electronic transmission of Pay Application, in lieu of paper copies.
- G. **Waivers of Mechanic's Lien:** With each Application for Payment, submit waivers of mechanic's lien from entities lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.
1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
 2. When an application shows completion of an item, submit conditional final or full waivers.
 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
 4. **Waiver Forms:** Submit executed waivers of lien on forms acceptable to Owner.
- H. **Initial Application for Payment:** Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
1. List of subcontractors.
 2. Schedule of values.
 3. Contractor's construction schedule (preliminary if not final).
 4. Combined Contractor's construction schedule (preliminary if not final) incorporating Work of multiple contracts, with indication of acceptance of schedule by each Contractor.
 5. Products list (preliminary if not final).
 6. Submittal schedule (preliminary if not final).
 7. List of Contractor's staff assignments.
 8. List of Contractor's principal consultants.
 9. Copies of building permits.
 10. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 11. Initial progress report.

12. Report of preconstruction conference.
 13. Certificates of insurance and insurance policies.
 14. Performance and payment bonds.
 15. Data needed to acquire Owner's insurance.
- I. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
 2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- J. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements.
 2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
 3. Updated final statement, accounting for final changes to the Contract Sum.
 4. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
 5. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
 6. AIA Document G707, "Consent of Surety to Final Payment."
 7. Evidence that claims have been settled.
 8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
 9. Final liquidated damages settlement statement.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

END OF SECTION 01 29 00

SECTION 01 31 00 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 - 1. General coordination procedures.
 - 2. Conservation.
 - 3. Correlation of Documents.
 - 4. Coordination drawings.
 - 5. Requests for Information (RFIs).
 - 6. Project Web site.
 - 7. Project meetings.
- B. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.
- C. Related Requirements:
 - 1. Division 01 Section - Multiple Contract Summary for a description of the division of work among separate contracts and responsibility for coordination activities not in this Section.
 - 2. Division 01 Section - Construction Progress Documentation for preparing and submitting Contractor's construction schedule.
 - 3. Division 01 Section - Execution for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
 - 4. Division 01 Section - Closeout Procedures for coordinating closeout of the Contract.

1.03 DEFINITIONS

- A. RFI: Request from Owner, Architect, or Contractor seeking information required by or clarifications of the Contract Documents.

1.04 INFORMATIONAL SUBMITTALS

- A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
 - 1. Name, address, and telephone number of entity performing subcontract or supplying products.
 - 2. Number and title of related Specification Section(s) covered by subcontract.
 - 3. Drawing number and detail references, as appropriate, covered by subcontract.
- B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, office, and cellular telephone numbers and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.

1. Post copies of list in project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.

1.05 GENERAL COORDINATION PROCEDURES

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections that depend on each other for proper installation, connection, and operation.
 1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
 3. Make adequate provisions to accommodate items scheduled for later installation.
- B. Coordination: Each contractor shall coordinate its construction operations with those of other contractors and entities to ensure efficient and orderly installation of each part of the Work. Each contractor shall coordinate its operations with operations, included in different Sections that depend on each other for proper installation, connection, and operation.
 1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 2. Coordinate installation of different components with other contractors to ensure maximum performance and accessibility for required maintenance, service, and repair.
 3. Make adequate provisions to accommodate items scheduled for later installation.
- C. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
 1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.
- D. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
 1. Preparation of Contractor's construction schedule.
 2. Preparation of the schedule of values.
 3. Installation and removal of temporary facilities and controls.
 4. Delivery and processing of submittals.
 5. Progress meetings.
 6. Preinstallation conferences.
 7. Project closeout activities.
 8. Startup and adjustment of systems.
- E. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
 1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

1.06 CORRELATION OF DOCUMENTS

- A. Any discrepancy in the documents shall be interpreted to include the most restrictive or costly solution. In case of discrepancy either in figures or Drawings or Specifications, the matter must be promptly submitted by the Contractor to the Architect, who will promptly make a determination in writing. Any adjustment by the Contractor without such a determination by the Architect will be at the Contractor's own risk and expense. The Architect will furnish, as necessary, additional detailed Drawings and information for clarification.
- B. If a document discrepancy is identified prior to bidding, the Architect is to be notified so a written clarification may be issued.
- C. Any survey drawing documents included herein are for convenience of the Contractor and Owner. The Architect assumes no responsibility as to their completeness or accuracy.
- D. Anything mentioned in the Specifications and not shown on the Drawings, or shown on the Drawings and not mentioned in the Specifications, is of like effect as if shown or mentioned in both.
- E. On any of the Drawings in which a portion of the work is detailed or drawn out and the remainder is shown in outline, the parts detailed or drawn out will apply also to all other like portions of the work.
- F. When the word "similar" appears on Drawings, it has a general meaning and must not be interpreted as meaning identical. All details must be worked out in relation to their location and connection with other parts of the work.
- G. Refer to Architectural Drawings for verification of locations, sizes and dimensions.

1.07 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
 - 1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
 - a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
 - b. Coordinate the addition of trade-specific information to the coordination drawings by multiple contractors in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
 - c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
 - d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
 - e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
 - f. Indicate required installation sequences.
 - g. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

- B. Coordination Drawing Organization: Organize coordination drawings as follows:
1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
 2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within ceiling plenum to accommodate layout of light fixtures indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
 3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
 4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
 5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
 6. Refer to Division 23 Section - Basic Mechanical Materials and Methods and Division 26 Section - Basic Electrical Materials and Methods for specific Coordination Drawing requirements for mechanical and electrical installations.
 7. Mechanical and Plumbing Work: Work to be shown shall include, but not be limited to the following:
 - a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
 - b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
 - c. Fire-rated enclosures around ductwork.
 8. Electrical Work: Work to be shown shall include, but not be limited to the following:
 - a. Runs of vertical and horizontal conduit 1-1/4 inches in diameter and larger.
 - b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
 - c. Panel board, switch board, switchgear, transformer, busway, generator, and motor control center locations.
 - d. Location of pull boxes and junction boxes, dimensioned from column center lines.
 9. Fire-Protection System: Work to be shown shall include, but not be limited to the following:
 - a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.
 10. Review: Architect will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make changes as directed and resubmit.
 11. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Division 01 Section - Submittal Procedures.
 12. Staff Names: Submit a list of principal staff assignments, including superintendent and other personnel in attendance at Project site with the bid proposal. Within 15 days of starting construction operations, identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home and office telephone numbers. Provide names, addresses, and telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.
 13. Post copies of list in Project meeting room, in temporary field office, and by each temporary telephone

1.08 REQUESTS FOR INFORMATION (RFI'S)

- A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
 - 1. Architect will return RFIs submitted to Architect by other entities controlled by Contractor with no response.
 - 2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
 - 1. Project name.
 - 2. Project number.
 - 3. Date.
 - 4. Name of Contractor.
 - 5. Name of Architect.
 - 6. RFI number, numbered sequentially.
 - 7. RFI subject.
 - 8. Specification Section number and title and related paragraphs, as appropriate.
 - 9. Drawing number and detail references, as appropriate.
 - 10. Field dimensions and conditions, as appropriate.
 - 11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 - 12. Contractor's signature.
 - 13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
 - a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
- C. RFI Forms: AIA Document G716 or Software-generated form with substantially the same content as indicated above, acceptable to Architect.
 - 1. Attachments shall be electronic files in Adobe Acrobat PDF format.
- D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow seven working days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.
 - 1. The following Contractor-generated RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for approval of Contractor's means and methods.
 - d. Requests for coordination information already indicated in the Contract Documents.
 - e. Requests for adjustments in the Contract Time or the Contract Sum.
 - f. Requests for interpretation of Architect's actions on submittals.
 - g. Incomplete RFIs or inaccurately prepared RFIs.
 - 2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt of additional information.
 - 3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Division 01 Section - Contract Modification Procedures.
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 10 days of receipt of the RFI response.

- E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log monthly. Include the following:
 - 1. Project name.
 - 2. Name and address of Contractor.
 - 3. Name and address of Architect.
 - 4. RFI number including RFIs that were returned without action or withdrawn.
 - 5. RFI description.
 - 6. Date the RFI was submitted.
 - 7. Date Architect's response was received.
- F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven days if Contractor disagrees with response.
 - 1. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
 - 2. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

1.09 PROJECT MEETINGS

- A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.
 - 1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
 - 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
 - 3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.
- B. Preconstruction Conference: Architect will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.
 - 1. Conduct the conference to review responsibilities and personnel assignments.
 - 2. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 - 3. Agenda: Discuss items of significance that could affect progress, including the following:
 - a. Tentative construction schedule.
 - b. Phasing.
 - c. Critical work sequencing and long-lead items.
 - d. Designation of key personnel and their duties.
 - e. Lines of communications.
 - f. Procedures for processing field decisions and Change Orders.
 - g. Procedures for RFIs.
 - h. Procedures for testing and inspecting.
 - i. Procedures for processing Applications for Payment.
 - j. Distribution of the Contract Documents.
 - k. Submittal procedures.
 - l. Preparation of record documents.
 - m. Use of the premises.
 - n. Work restrictions.

- o. Working hours.
 - p. Owner's occupancy requirements.
 - q. Responsibility for temporary facilities and controls.
 - r. Procedures for moisture and mold control.
 - s. Procedures for disruptions and shutdowns.
 - t. Construction waste management and recycling.
 - u. Parking availability.
 - v. Office, work, and storage areas.
 - w. Equipment deliveries and priorities.
 - x. First aid.
 - y. Security.
 - z. Progress cleaning.
4. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
- C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.
- 1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect, and Owner's Commissioning Authority of scheduled meeting dates.
 - 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
 - a. Contract Documents.
 - b. Options.
 - c. Related RFIs.
 - d. Related Change Orders.
 - e. Purchases.
 - f. Deliveries.
 - g. Submittals.
 - h. Review of mockups.
 - i. Possible conflicts.
 - j. Compatibility requirements.
 - k. Time schedules.
 - l. Weather limitations.
 - m. Manufacturer's written instructions.
 - n. Warranty requirements.
 - o. Compatibility of materials.
 - p. Acceptability of substrates.
 - q. Temporary facilities and controls.
 - r. Space and access limitations.
 - s. Regulations of authorities having jurisdiction.
 - t. Testing and inspecting requirements.
 - u. Installation procedures.
 - v. Coordination with other work.
 - w. Required performance results.
 - x. Protection of adjacent work.
 - y. Protection of construction and personnel.
 - 3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
 - 4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.

5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- D. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than 90 days prior to the scheduled date of Substantial Completion.
1. Conduct the conference to review requirements and responsibilities related to Project closeout.
 2. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:
 - a. Preparation of record documents.
 - b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
 - c. Submittal of written warranties.
 - d. Requirements for preparing operations and maintenance data.
 - e. Requirements for delivery of material samples, attic stock, and spare parts.
 - f. Requirements for demonstration and training.
 - g. Preparation of Contractor's punch list.
 - h. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
 - i. Submittal procedures.
 - j. Coordination of separate contracts.
 - k. Owner's partial occupancy requirements.
 - l. Installation of Owner's furniture, fixtures, and equipment.
 - m. Responsibility for removing temporary facilities and controls.
 4. Minutes: Entity conducting meeting will record and distribute meeting minutes.
- E. Progress Meetings: Conduct progress meetings at monthly intervals.
1. Coordinate dates of meetings with preparation of payment requests.
 2. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - 1) Review schedule for next period.
 - b. Review present and future needs of each entity present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Resolution of BIM component conflicts.

- 4) Status of submittals.
 - 5) Deliveries.
 - 6) Off-site fabrication.
 - 7) Access.
 - 8) Site utilization.
 - 9) Temporary facilities and controls.
 - 10) Progress cleaning.
 - 11) Quality and work standards.
 - 12) Status of correction of deficient items.
 - 13) Field observations.
 - 14) Review recording of changes on record field set.
 - 15) Safety
 - 16) Work hours
 - 17) Status of RFIs.
 - 18) Status of proposal requests.
 - 19) Pending changes.
 - 20) Status of Change Orders.
 - 21) Pending claims and disputes.
 - 22) Documentation of information for payment requests.
4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
 - a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

END OF SECTION 01 31 00

SECTION 01 32 00 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
 - 1. Startup construction schedule.
 - 2. Contractor's construction schedule.
 - 3. Submittals schedule
 - 4. Construction schedule updating reports.
 - 5. Daily construction reports.
 - 6. Material location reports.
 - 7. Site condition reports.
 - 8. As-Built documentation.
 - 9. Special reports.
 - 10. Construction photographs.
- B. Related Requirements:
 - 1. Division 01 Section - Payment Procedures for submitting the Schedule of Values.
 - 2. Division 01 Section - Project Management and Coordination for submitting and distributing meeting and conference minutes.
 - 3. Division 01 Section - Submittal Procedures for submitting schedules and reports.
 - 4. Division 01 Section - Quality Requirements for submitting a schedule of tests and inspections.
 - 5. Division 01 Section - Closeout Procedures for submitting photographic negatives as Project Record Documents at Project closeout.

1.03 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.
 - 1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
 - 2. Predecessor Activity: An activity that precedes another activity in the network.
 - 3. Successor Activity: An activity that follows another activity in the network.

1.04 INFORMATIONAL SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format:
 - 1. Working electronic copy of schedule file, where indicated.
 - 2. PDF electronic file.
- B. Startup construction schedule.
- C. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
- D. Construction Schedule Updating Reports: Submit with Applications for Payment.

- E. Construction Photographs: Submit electronic copies of each photographic view with Application for Payment.
 - 1. Format: jpeg electronic file
 - 2. Submit a complete set of photographs on CD as a Project Record Document. Identify date photographs were taken.
- F. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- G. Submittals Schedule: Submit three copies of schedule. Arrange the following information in a tabular format:
 - 1. Scheduled date for first submittal.
 - 2. Specification Section number and title.
 - 3. Submittal category (action or informational).
 - 4. Name of subcontractor.
 - 5. Description of the Work covered.
 - 6. Scheduled date for Architect's final release or approval.
- H. Daily Construction Reports: Submit at monthly intervals.
- I. Material Location Reports: Submit at monthly intervals.
- J. Site Condition Reports: Submit at time of discovery of differing conditions.
- K. Special Reports: Submit at time of unusual event.

1.05 COORDINATION

- A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.
- B. Coordinate Contractor's construction schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests, and other required schedules and reports.
 - 1. Secure time commitments for performing critical elements of the Work from entities involved.
 - 2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.
- C. Auxiliary Services: Cooperate with photographer and provide auxiliary services requested, including access to Project site and use of temporary facilities including temporary lighting.

PART 2 - PRODUCTS

2.01 SUBMITTALS SCHEDULE

- A. Preparation: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, resubmittal, ordering, manufacturing, fabrication, and delivery when establishing dates.
 - 1. Coordinate Submittals Schedule with list of subcontracts, the Schedule of Values, and Contractor's Construction Schedule.
 - 2. Initial Submittal: Submit concurrently with preliminary bar-chart schedule. Include submittals required during the first 60 days of construction. List those required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
 - a. At Contractor's option, show submittals on the Preliminary Construction Schedule, instead of tabulating them separately.

3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's Construction Schedule.

2.02 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Time Frame: Extend schedule from date established for Notice of Award to date of final completion.
 1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- B. Activities: Treat each story or separate area as a separate numbered activity for each main element of the Work. Comply with the following:
 1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
 2. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
 3. Submittal Review Time: Include review and resubmittal times indicated in Division 01 Section - Submittal Procedures in schedule. Coordinate submittal review times in Contractor's construction schedule with submittal schedule.
 4. Startup and Testing Time: Include no fewer than 15 days for startup and testing.
 5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
 6. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and final completion.
- C. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
 1. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
 2. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Division 01 Section - Summary. Delivery dates indicated stipulate the earliest possible delivery date.
 3. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Division 01 Section - Summary. Delivery dates indicated stipulate the earliest possible delivery date.
 4. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
 - a. Subcontract awards.
 - b. Submittals.
 - c. Purchases.
 - d. Mockups.
 - e. Fabrication.
 - f. Sample testing.
 - g. Deliveries.
 - h. Installation.
 - i. Tests and inspections.
 - j. Adjusting.
 - k. Curing.
 5. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:

- a. Structural completion.
 - b. Temporary enclosure and space conditioning.
 - c. Permanent space enclosure.
 - d. Completion of mechanical installation.
 - e. Completion of electrical installation.
 - f. Substantial Completion.
- D. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and final completion, and the following interim milestones:
- 1. Temporary enclosure and space conditioning.
- E. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
- 1. Unresolved issues.
 - 2. Unanswered Requests for Information.
 - 3. Rejected or unreturned submittals.
 - 4. Notations on returned submittals.
 - 5. Pending modifications affecting the Work and Contract Time.
- F. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, and equipment required to achieve compliance, and date by which recovery will be accomplished.
- G. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.

2.03 CONTRACTOR'S CONSTRUCTION SCHEDULE (GANTT CHART)

- A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal, Gantt-chart-type, Contractor's construction schedule within 30 days of date established for the Notice of Award. Base schedule on the startup construction schedule and additional information received since the start of Project.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.

2.04 REPORTS

- A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:
 - 1. List of subcontractors at Project site.
 - 2. List of separate contractors at Project site.
 - 3. Approximate count of personnel at Project site.
 - 4. Equipment at Project site.
 - 5. Material deliveries.
 - 6. High and low temperatures and general weather conditions, including presence of rain or snow.
 - 7. Accidents.
 - 8. Meetings and significant decisions.
 - 9. Unusual events (see special reports).
 - 10. Stoppages, delays, shortages, and losses.
 - 11. Meter readings and similar recordings.
 - 12. Emergency procedures.
 - 13. Orders and requests of authorities having jurisdiction.

14. Change Orders received and implemented.
 15. Construction Change Directives received and implemented.
 16. Services connected and disconnected.
 17. Equipment or system tests and startups.
 18. Partial completions and occupancies.
 19. Substantial Completions authorized.
- B. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

2.05 AS-BUILT DOCUMENTATION

- A. Contractor shall record changes to the Construction Documents where the constructed work deviates from that which is shown. This “As-Built” documentation shall be recorded in “Red” on a dedicated field set at the trailer.

PART 3 - EXECUTION

3.01 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
 2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
 3. As the Work progresses, indicate final completion percentage for each activity.
- B. Distribution: Distribute copies of approved schedule to Architect, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
1. Post copies in Project meeting rooms and temporary field offices.
 2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

3.02 CONSTRUCTION PHOTOGRAPHS

- A. Format: digital, jpeg
- B. Date Stamp: Unless otherwise indicated, date and time stamp each photograph as it is being taken so stamp is integral to photograph.
- C. Preconstruction Photographs: Before starting construction, take twelve color photographs of Project site and surrounding properties from different vantage points, as directed by Architect. Show existing conditions adjacent to property.
- D. Periodic Construction Photographs: Take twelve color photographs monthly, coinciding with cutoff date associated with each Application for Payment. Photographer shall select vantage points to best show status of construction and progress since last photographs were taken.
- E. Final Completion Construction Photographs: Take twelve color photographs after date of Substantial Completion for submission as Project Record Documents. Architect will direct photographer for desired vantage points.

END OF SECTION 01 32 00

SECTION 01 32 33 - PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
 - 1. Preconstruction photographs.
 - 2. Periodic construction photographs.
 - 3. Final completion construction photographs.
 - 4. Web-based construction photographic documentation.
- B. Related Requirements:
 - 1. Division 01 Section - Unit Prices for procedures for unit prices for extra photographs.
 - 2. Division 01 Section - Submittal Procedures for submitting photographic documentation.
 - 3. Division 01 Section - Closeout Procedures for submitting photographic documentation as project record documents at Project closeout.
 - 4. Division 01 Section - Demonstration and Training for submitting video recordings of demonstration of equipment and training of Owner's personnel.
 - 5. Division 02 Section - Structure Demolition for photographic documentation before building demolition operations commence.
 - 6. Division 02 Section - Selective Structure Demolition for photographic documentation before selective demolition operations commence.
 - 7. Division 31 Section - Site Clearing for photographic documentation before site clearing operations commence.

1.03 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Web-based photographic documentation service provider.
- B. Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each photograph. Indicate elevation or story of construction. Include same information as corresponding photographic documentation.
- C. Digital Photographs: Submit image files within three days of taking photographs.
 - 1. Digital Camera: Minimum sensor resolution of 8 megapixels.
 - 2. Format: Minimum 3200 by 2400 pixels, in unaltered original files, with same aspect ratio as the sensor, uncropped, date and time stamped, in folder named by date of photograph, accompanied by key plan file.
 - 3. Identification: Provide the following information with each image description in file metadata tag:
 - a. Name of Project.
 - b. Name and contact information for photographer.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Date photograph was taken.
 - f. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
 - g. Unique sequential identifier keyed to accompanying key plan.

- D. Web-Based Photographic Documentation: Submit time-lapse sequence video recordings simultaneously with recording.
 - 1. Submit time-lapse sequence video recordings by posting to Web-based photographic documentation service provider's Web site.
 - 2. Identification: For each recording, provide the following information:
 - a. Name of Project.
 - b. Name and contact information for photographer.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Date(s) and time(s) video recording was recorded.
 - f. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
 - g. Weather conditions at time of recording.

1.04 QUALITY ASSURANCE

- A. Web-Based Photographic Documentation Service Provider: A firm specializing in providing photographic equipment, Web-based software, and related services for construction projects, with record of providing satisfactory services similar to those required for Project.

1.05 USAGE RIGHTS

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

PART 2 - PRODUCTS

2.01 PHOTOGRAPHIC MEDIA

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

2.02 WEB-BASED PHOTOGRAPHIC DOCUMENTATION

- A. Project Camera: Provide fixed exterior camera installation, mounted to provide unobstructed view of construction site from location approved by Architect.
 - 1. Provide two (2) fixed-location cameras, with the following characteristics:
 - a. Static view
 - b. Capable of producing minimum 3.0 megapixel pictures.
 - c. Provide power supply, active high-speed data connection to service provider's network, and static public IP address for each camera.
- B. Web-Based Image Access: Password-protected access for Project team administered by Contractor, providing current image access and archival image access by date and time, with images downloadable to viewer's device.
 - 1. Provide public viewer open access to most recent project camera image.

PART 3 - EXECUTION

3.01 CONSTRUCTION PHOTOGRAPHS

- A. General: Take photographs using the maximum range of depth of field, and that are in focus, to clearly show the Work. Photographs with blurry or out-of-focus areas will not be accepted.
 - 1. Maintain key plan with each set of construction photographs that identifies each photographic location.

- B. Digital Images: Submit digital images exactly as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.
 - 1. Date and Time: Include date and time in file name for each image.
 - 2. Field Office Images: Maintain one set of images accessible in the field office at Project site, available at all times for reference. Identify images in the same manner as those submitted to Architect.
- C. Preconstruction Photographs: Before commencement of demolition take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Architect.
 - 1. Take 20 photographs of existing buildings either on or adjoining property to accurately record physical conditions at start of construction.
 - 2. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.
- D. Periodic Construction Photographs: Take 24 photographs weekly, with timing each month adjusted to coincide with the cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last photographs were taken.
- E. Final Completion Construction Photographs: Take 24 color photographs after date of Substantial Completion for submission as project record documents. Architect will inform photographer of desired vantage points.
- F. Additional Photographs: Architect may request photographs in addition to periodic photographs specified. Additional photographs will be paid for by Change Order and are not included in the Contract Sum.
 - 1. Three days' notice will be given, where feasible.
 - 2. In emergency situations, take additional photographs within 24 hours of request.
 - 3. Circumstances that could require additional photographs include, but are not limited to, the following:
 - a. Special events planned at Project site.
 - b. Immediate follow-up when on-site events result in construction damage or losses.
 - c. Photographs to be taken at fabrication locations away from Project site. These photographs are not subject to unit prices or unit-cost allowances.
 - d. Substantial Completion of a major phase or component of the Work.
 - e. Extra record photographs at time of final acceptance.
 - f. Owner's request for special publicity photographs.

3.02 WEB-BASED CONSTRUCTION PHOTOGRAPHIC DOCUMENTATION

- A. Live Streaming Construction Site Images: Provide Web-accessible image of current site image from fixed location camera(s), updated at 15 minute intervals during daytime operation.
- B. Time-Lapse Sequence Construction Site Recordings: Provide video recording from a fixed-location camera to show status of construction and progress.
 - 1. Frequency: Record one frame of video recording every 15 minutes, from same vantage point each time, to create a time-lapse sequence of construction activities.
 - 2. Timer: Provide timer to automatically start and stop video recorder so recording occurs only during daylight construction work hours.
- C. Maintain cameras and Web-based access in good working order according to Web-based construction photographic documentation service provider's written instructions until final completion. Provide for service of cameras and related networking devices and software.

END OF SECTION 01 32 33

SECTION 01 33 00 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.
- B. Related Requirements:
 - 1. Division 01 Section - Payment Procedures for submitting Applications for Payment and the schedule of values.
 - 2. Division 01 Section - Project Management and Coordination for submitting Coordination Drawings.
 - 3. Division 01 Section - Construction Progress Documentation for submitting schedules and reports, including Contractor's construction schedule.
 - 4. Division 01 Section - Operation and Maintenance Data for submitting operation and maintenance manuals.
 - 5. Division 01 Section - Project Record Documents for submitting record Drawings, record Specifications, and record Product Data.
 - 6. Division 01 Section - Closeout Procedures for submitting warranties Project Record Documents and operation and maintenance manuals.

1.03 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."
- B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."
- C. File Transfer Protocol (FTP): Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.
- D. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

1.04 ACTION SUBMITTALS

- A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.
 - 1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.

2. Initial Submittal: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule.
 - a. Submit revised submittal schedule to reflect changes in current status and timing for submittals.
4. Format: Arrange the following information in a tabular format:
 - a. Scheduled date for first submittal.
 - b. Specification Section number and title.
 - c. Submittal category: Action; informational.
 - d. Name of subcontractor.
 - e. Description of the Work covered.
 - f. Scheduled date for Architect's final release or approval.
 - g. Scheduled date of fabrication.

1.05 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

- A. Architect's Digital Data Files: Electronic digital data files of the Contract Drawings may be provided by Architect for Contractor's use in preparing submittals.
 1. Architect may furnish Contractor specifically requested digital data drawing files of the Contract Drawings for use in preparing Shop Drawings.
 - a. Architect makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.
 - b. Digital Drawing Software Program: The Contract Drawings are available in AutoCad.
 - c. Contractor shall execute a data licensing agreement in the form of an Agreement acceptable to Architect, as a prerequisite for Architect providing electronic files. Architect's consultants may require additional agreements as condition for release of their electronic files.
 - 1) Contractor shall bind all parties receiving or using these files to the same agreements.
 - d. The following digital data files may be furnished for each appropriate discipline:
 - 1) Site plan.
 - 2) Architectural floor plans.
 - 3) Drawings specifically requested by Contractor and agreed to be provided by the Architect and Architect's consultants.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
 3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
 4. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
 2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
 3. Resubmittal Review: Allow 15 days for review of each resubmittal.
 4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 21 days for initial review of each submittal.
 5. Concurrent Review of Submittals: Where two or more submittals require concurrent review, Architect retains the right to hold submittals until all submittals required for concurrent review are received. Architect will notify Contractor of necessity for concurrent submittals after a submittal is received in absence of other related submittals required for concurrent review. The date of receipt of the last submittal required for concurrent review will be considered the date for the start of Architect's review time.
 - a. Examples of submittals for concurrent review include, but are not limited to: Roofing and related flashing, accessories, and waterproofing installed by roofer; doors, door frames, and hardware submittals; and window or glazing systems and glass.
- D. Transmittals for Electronic Submittals: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect will return without review or discard any submittals received from sources other than the Contractor. Package each submittal individually. Do not group different specification sections together in one submittal. Provide transmittal form including the following information:
1. Submittal number unique identifier, including revision identifier, and with identification of submittal contents as follows:
 - a. Submittal number shall use Specification Section number followed by a dash and then a sequential number (e.g., 061000-01). Resubmittals shall include the letter R and a sequential number after another dash (e.g., 061000-01-R1), or next sequential number.
 - b. Name of Specification Section, with brief description of submittal contents for sections requiring multiple submittals.
 2. Overall sequence number each submittal starting with number 1 for the first submittal transmitted to the Architect, 2 for the second and so forth, indicating the chronological submission of each submittal.
 3. Provide means for insertion to permanently record Contractor's review and approval markings. Indicate Contractor's completed review prior to submitting to Architect.
 4. Include the following information for processing and recording:
 - a. Project name.
 - b. Date of submission to Architect.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Additionally, indicate names of the following, as applicable, including indication of the entity that prepared each submittal:
 - 1) Name of subcontractor.
 - 2) Name of supplier / vendor.
 - 3) Name of manufacturer.
 - f. Drawing number and detail references, as appropriate.

- g. Location(s) where product is to be installed, as appropriate.
 - h. Remarks and other necessary identification.
 - i. Signature of transmitter.
- E. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:
 - 1. Assemble complete submittal package into a single indexed .pdf format file, or .pdf files within a .zip file where multiple files cannot be avoided, incorporating submittal requirements of a single Specification Section and transmittal form. Name file according to Submittal number and contents identification.
 - 2. Architect, and Architect's consultants as applicable, will return electronic submittal with annotations containing their comments as applicable.
- F. Options: Circle or highlight options to be provided on product data and specification sheets. Identify options requiring selection by Architect with red colored boxes or text.
- G. Deviations and Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.
- H. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
 - 1. Note date and content of previous submittal.
 - 2. Note date and content of revision in label or title block and clearly indicate extent of revision.
 - 3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.
- I. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- J. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

PART 2 - PRODUCTS

2.01 SUBMITTAL PROCEDURES

- A. Organization: All required submittals for a specification section must be transmitted together complete as one submittal transmittal. Partial transmittals will not be accepted for review.
- B. Contractor's responsibilities:
 - 1. Contractor shall thoroughly check shop drawings, project data and samples for compliance with Contract Documents and list variances prior to submission.
 - 2. Contractor represents by approving and submitting Shop Drawings, Product Data and samples that he has or will coordinate and verify dimensions, all materials, field measurements, field construction criteria, catalog numbers and similar data with requirements of work and of Contract Documents prior to submitting.
 - 3. Submittals shall bear Contractor's stamp and initials certifying that they have been checked. Submittals without stamp & initials shall be returned un-reviewed.
 - 4. Contractor's responsibility for deviations or errors and omissions in submittals is not relieved by Architect/ Engineer review of submittals, unless Architect/ Engineer gives specific written acceptance of specific deviations.

5. Do not proceed with purchasing, fabrication or delivery of work which requires submittals until return of submittals with Architect/Engineer stamp and initials or signature evidencing final review and approval of submittals.
 6. Contractor is responsible for dimensions at job site, quantities, coordinating component parts and trades to effect unified construction and implement construction techniques, safety of incremental units, and satisfactory performance of work in accordance with Contract Documents.
 7. Delays caused by failure of Contractor to check shop drawings and to stamp with this approval shall be Contractor's responsibility.
 8. Coordinate preparation and processing of submittals with performance of work to avoid delays.
 9. No extension of time shall be allowed because of failure to properly coordinate and sequence submittals.
- C. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
1. Submit electronic submittals via email or FTP as PDF format electronic files.
 - a. Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.
 2. Certificates and Certifications Submittals: Provide a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
- D. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
 2. Mark each copy of each submittal to show which products and options are applicable.
 3. Include the following information, as applicable:
 - a. Manufacturer's catalog cuts.
 - b. Manufacturer's product specifications.
 - c. Standard color charts.
 - d. Statement of compliance with specified referenced standards.
 - e. Testing by recognized testing agency.
 - f. Application of testing agency labels and seals.
 - g. Notation of coordination requirements.
 - h. Availability and delivery time information.
 4. For equipment, include the following in addition to the above, as applicable:
 - a. Wiring diagrams showing factory-installed wiring.
 - b. Printed performance curves.
 - c. Operational range diagrams.
 - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
 5. Submit Product Data before or concurrent with Samples.
- E. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data unless the submittal is based on Architect's digital data drawing files, and is specifically permitted.
1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Identification of products.

- b. Schedules.
 - c. Compliance with specified standards.
 - d. Notation of coordination requirements.
 - e. Notation of dimensions established by field measurement.
 - f. Relationship and attachment to adjoining construction clearly indicated.
 - g. Seal and signature of professional engineer if specified.
2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 x 11 inches, but no larger than 30 x 42 inches .
- F. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
- 1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
 - 2. Identification: Attach label on unexposed side of Samples that includes the following:
 - a. Generic description of Sample.
 - b. Product name and name of manufacturer.
 - c. Sample source.
 - d. Number and title of applicable Specification Section.
 - e. Specification paragraph number and generic name of each item.
 - 3. For projects where electronic submittals are required, provide corresponding electronic submittal of Sample transmittal, digital image file illustrating Sample characteristics, and identification information for record.
 - 4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
 - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
 - 5. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
 - a. Number of Samples: Unless otherwise indicated, submit two full sets of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.
 - b. Selector sheets printed by Contractor, and website information, are not acceptable samples for selection. Submit Manufacturer's selector sheets and samples with accurate color and texture representation as applicable.
 - 6. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
 - a. Number of Samples: Unless otherwise indicated, submit two sets of Samples. Architect will retain both Sample sets.
 - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.

- 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least two sets of paired units that show approximate limits of variations.
- G. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
 2. Manufacturer and product name, and model number if applicable.
 3. Number and name of room or space.
 4. Location within room or space.
 5. Submit product schedule in the following format:
 - a. PDF electronic file.

2.02 INFORMATION SUBMITTALS

- A. General: Prepare and submit Informational Submittals required by other Specification Sections.
1. Number of Copies: Submit two copies of each submittal, unless otherwise indicated. Architect will not return copies.
 2. Certificates and Certifications: Provide a notarized statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
 3. Test and Inspection Reports: Comply with requirements in Division 1 Section - Quality Requirements.
- B. Coordination Drawing Submittals: Comply with requirements specified in Division 01 Section - Project Management and Coordination.
- C. Contractor's Construction Schedule: Comply with requirements specified in Division 01 Section - Construction Progress Documentation.
- D. Application for Payment and Schedule of Values: Comply with requirements specified in Division 01 Section - Payment Procedures.
- E. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Division 01 Section - Quality Requirements.
- F. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Division 01 Section - Closeout Procedures.
- G. Maintenance Data: Comply with requirements specified in Division 01 Section - Operation and Maintenance Data.
- H. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- I. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.
- J. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.

- K. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
- L. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- M. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- N. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
- O. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
- P. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
 - 1. Name of evaluation organization.
 - 2. Date of evaluation.
 - 3. Time period when report is in effect.
 - 4. Product and manufacturers' names.
 - 5. Description of product.
 - 6. Test procedures and results.
 - 7. Limitations of use.
- Q. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
- R. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
- S. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
- T. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

2.03 DELEGATED-DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
 - 1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

- B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF electronic file, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
 - 1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

PART 3 - EXECUTION

3.01 CONTRACTOR'S REVIEW

- A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
- B. Project Closeout and Maintenance Material Submittals: See requirements in Division 01 Section - Closeout Procedures.
- C. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.02 ARCHITECT'S ACTION

- A. Action Submittals:
 - 1. Architect will review each submittal, make marks to indicate corrections or revisions required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action, as follows:
 - a. No exceptions taken.
 - b. Make corrections as noted.
 - c. Revise and resubmit.
 - d. Rejected.
 - e. Other.
 - 2. Submittals or items stamped "No exceptions taken" indicates that Architect does not require resubmittal, and may include comments such as Architect's selection of options.
 - 3. Submittals or items stamped "Make corrections as noted" indicates that Architect does not require resubmittal if the annotated corrections are made. However, items or submittals with this action noted may require resubmittal if:
 - a. Contractor believes indicated corrections are not correct responses, and requires subsequent review. Resubmittal should indicate Contractor's reasons for concern and additional supporting information as applicable.
 - b. Contractor believes a resubmittal is required to address or confirm additional questions through subsequent review, related to items not considered by the original submittal or that were brought to light by Architect's previous review comments.
 - 4. Revise and resubmit items or submittals stamped "revise and resubmit" and "rejected", to address all comments requiring resubmittal and the reasons for rejection.
 - 5. When "Other" action is indicated, Architect will provide additional comment describing the subsequent action required.
 - 6. Submittals may be stamped with more than one action regarding portions of the submittal, and may note that only portions of the original submittal are required to be resubmitted.

- B. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.
- C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.
- D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- E. Submittals not required by the Contract Documents may be returned by the Architect without action.

END OF SECTION 01 33 00



SUBMITTAL TRANSMITTAL

Project: _____ Date: _____
A/E Project Number: _____

TRANSMITTAL To (Contractor): _____ Date: _____ Submittal No. _____
A From (Subcontractor): _____ By: _____ ☐ Resubmission

Qty.	Reference / Number	Title / Description / Manufacturer	Spec. Section Title and Paragraph / Drawing Detail Reference

- ☐ Submitted for review and approval
☐ Resubmitted for review and approval
☐ Complies with contract requirements
☐ Will be available to meet construction schedule
☐ A/E review time included in construction schedule

- ☐ Substitution involved - Substitution request attached
☐ If substitution involved, submission includes point-by-point comparative data or preliminary details
☐ Items included in submission will be ordered immediately upon receipt of approval

Other remarks on above submission: _____

☐ One copy retained by sender

TRANSMITTAL To (A/E): _____ Attn: _____ Date Rec'd by Contractor: _____
B From (Contractor): _____ By: _____ Date Trnsmt'd by Contractor: _____

- ☐ Approved
☐ Approved as noted

- ☐ Revise / Resubmit
☐ Rejected / Resubmit

Other remarks on above submission: _____

☐ One copy retained by sender

TRANSMITTAL To (Contractor): _____ Attn: _____ Date Rec'd by A/E: _____
C From (A/E): _____ ☐ Other By: _____ Date Trnsmt'd by A/E: _____

- ☐ Approved
☐ Approved as noted
☐ Not subject to review
☐ No action required
☐ Revise / Resubmit
☐ Rejected / Resubmit
☐ Approved as noted / Resubmit

- ☐ Provide file copy with corrections identified
☐ Sepia copies only returned
☐ Point-by-point comparative data required to complete approval process
☐ Submission Incomplete / Resubmit

Other remarks on above submission: _____

☐ One copy retained by sender

TRANSMITTAL To (Subcontractor): _____ Attn: _____ Date Rec'd by Contractor: _____
D From (Contractor): _____ By: _____ Date Trnsmt'd by Contractor: _____

Copies: ☐ Owner ☐ Consultants ☐ _____ ☐ _____ ☐ _____ ☐ One copy retained by sender

SECTION 01 40 00 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specific quality-control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
 - 2. Specified tests, inspections, and related actions do not limit Contractor's quality-control procedures that facilitate compliance with the Contract Document requirements.
 - 3. Requirements for Contractor to provide quality-control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.
- C. Related Sections include the following:
 - 1. Division 1 Section - Construction Progress Documentation for developing a schedule of required tests and inspections.
 - 2. Division 1 Section - Cutting and Patching for repair and restoration of construction disturbed by testing and inspecting activities.
 - 3. Divisions 2 - 48 Sections for additional specific test and inspection requirements.

1.03 DEFINITIONS

- A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and ensure that proposed construction complies with requirements.
- B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that completed construction complies with requirements. Services do not include contract enforcement activities performed by Architect.
- C. Mockups: Full-size, physical example assemblies to illustrate finishes and materials. Mockups are used to verify selections made under Sample submittals, to demonstrate aesthetic effects and, where indicated, qualities of materials and execution, and to review construction, coordination, testing, or operation; they are not Samples. Mockups establish the standard by which the Work will be judged.
- D. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- E. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.04 DELEGATED DESIGN

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
 - 1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

1.05 CONFLICTING REQUIREMENTS

- A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect for a decision before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.06 SUBMITTALS

- A. Qualification Data: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- B. Delegated-Design Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit a statement, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.
- C. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility sent to authorities having jurisdiction before starting work on the following systems:
 - 1. Seismic-force-resisting system, designated seismic system, or component listed in the designated seismic system quality-assurance plan prepared by Architect.
 - 2. Main wind-force-resisting system or a wind-resisting component listed in the wind-force-resisting system quality-assurance plan prepared by Architect.
- D. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
 - 1. Specification Section number and title.
 - 2. Description of test and inspection.
 - 3. Identification of applicable standards.
 - 4. Identification of test and inspection methods.
 - 5. Number of tests and inspections required.
 - 6. Time schedule or time span for tests and inspections.
 - 7. Entity responsible for performing tests and inspections.
 - 8. Requirements for obtaining samples.
 - 9. Unique characteristics of each quality-control service.
- E. Reports: Prepare and submit certified written reports that include the following:
 - 1. Date of issue.

2. Project title and number.
 3. Name, address, and telephone number of testing agency.
 4. Dates and locations of samples and tests or inspections.
 5. Names of individuals making tests and inspections.
 6. Description of the Work and test and inspection method.
 7. Identification of product and Specification Section.
 8. Complete test or inspection data.
 9. Test and inspection results and an interpretation of test results.
 10. Ambient conditions at time of sample taking and testing and inspecting.
 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 12. Name and signature of laboratory inspector.
 13. Recommendations on retesting and reinspecting.
- F. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.07 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- B. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- C. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- D. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that is similar to those indicated for this Project in material, design, and extent.
- F. Specialists: Certain sections of the Specifications require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
1. Requirement for specialists shall not supersede building codes and similar regulations governing the Work, nor interfere with local trade-union jurisdictional settlements and similar conventions.
- G. Testing Agency Qualifications: An agency with the experience and capability to conduct testing and inspecting indicated, as documented by ASTM E 548, and that specializes in types of tests and inspections to be performed.
1. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect with copy to Contractor.

Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

- H. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
 - 1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.
 - 2. Notify Architect seven days in advance of dates and times when mockups will be constructed.
 - 3. Demonstrate the proposed range of aesthetic effects and workmanship.
 - 4. Obtain Architect's approval of mockups before starting work, fabrication, or construction.
 - 5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 - 6. Demolish and remove mockups when directed, unless otherwise indicated.

1.08 QUALITY CONTROL

- A. Owner Responsibilities: The Owner will hire and pay for tests and inspections, unless explicitly assigned to Contractor. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.
 - 1. Contractor shall engage and pay for Mechanical HVAC systems testing adjusting and balancing services. Refer to Division 23 for Testing, Adjusting and Balancing specifications.
 - 2. Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
 - 3. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged by Owner and a description of the types of testing and inspecting they are engaged to perform.
 - 4. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor.
- B. Contractor Responsibilities: Unless otherwise indicated, provide quality-control services specified and required by authorities having jurisdiction.
 - 1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
 - a. Contractor shall not employ the same entity engaged by Owner, unless agreed to in writing by Owner.
 - 2. Notify testing agencies, Engineer & Architect at least 72 hours in advance of time when Work that requires testing or inspecting will be performed.
 - 3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
 - 4. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 - 5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. Special Tests and Inspections: Engage a qualified testing agency to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner.
 - 1. Testing agency will notify Architect, and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
 - 2. Testing agency will submit a certified written report of each test, inspection, and similar quality-control service to Architect with copy to Contractor and to authorities having jurisdiction.

3. Testing agency will submit a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
 4. Testing agency will interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.
 5. Testing agency will retest and re-inspect corrected work.
- D. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing.
- E. Retesting/Reinspections: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspections, for construction that revised or replaced Work that failed to comply with requirements established by the Contract Documents.
- F. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 2. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
 3. Submit a certified written report of each test, inspection, and similar quality-control service to recipients on the distribution list as established by Architect, or in the absence of that, through Contractor.
 4. Do not release, revoke, alter, or increase requirements of the Contract Documents or approve or accept any portion of the Work.
 5. Do not perform any duties of Contractor.
- G. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
 4. Facilities for storage and field-curing of test samples.
 5. Delete first subparagraph below if not required or common practice in Project vicinity.
 6. Delivery of samples to testing agencies.
 7. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 8. Security and protection for samples and for testing and inspecting equipment at Project site.
- H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.
- I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Submit schedule within 30 days of date established for the Notice to Proceed.
1. Distribution: Distribute schedule to Owner, Architect, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.01 EARTHWORK AND TESTING

- A. Inspect and approve subgrade prior to placing material.
- B. Perform relative compaction testing determined as outlined in ASTM D-1557.
- C. Perform moisture density test for each soil type determined as outlined in ASTM D-698.
- D. Field density tests shall be made at all fill areas at backfill and at existing subgrade; no less than two tests per lift.
- E. Filling and Backfilling:
 - 1. The Contractor shall make available to the laboratory, adequate samples of each fill and backfill material from the proposed sources of supply not less than 10 days prior to the start of the work.
 - 2. The Laboratory shall analyze the samples as required to provide a soil description and to determine compliance with the quality requirements.
 - a. Test for liquid limit in accordance with ASTM D423.
 - b. Test for plastic limit of soils and plasticity index of soils in accordance with ASTM D424.
 - c. Test for moisture density relations of soil in accordance with ASTM D698.
 - 3. Furnish a report for each individual test and state whether sample conforms to the specified requirements or reasons for nonconformance.
 - 4. Inspect and approve subgrade prior to placement of fill material.
 - 5. Make in-place compaction tests for moisture content, moisture-density relationship, and density of fill materials.
 - 6. Perform not less than two compaction tests for each 3,000 SF of surface for each layer of fill under the building and not less than two compaction tests for each 5,000 SF of surface for each layer of fill or undisturbed earth on areas of site to be covered by paving walks or traffic approaches.

3.02 DRILLED PIER INSPECTION

- A. The Contractor shall pay for services by a qualified soils laboratory to provide inspection of pier drilling operations as follows:
 - 1. Qualified soils personnel on site for pier drilling operation inspection.
 - 2. The laboratory representative shall remain on the site until the Contractor can properly identify the bearing formations with accuracy and without assistance from the laboratory.
 - 3. Should any unusual conditions be encountered during drilling operations, the laboratory shall be contacted immediately so that additional inspection can be provided.
 - 4. The lab report shall:
 - a. Identify each pier drilled;
 - b. The date and time of drilling and concrete placement;
 - c. Verify pier and bell diameters;
 - d. Depth of pier from surface;
 - e. Depth of bearing stratum from surface;
 - f. Required and actual penetration;
 - g. Depth from top of concrete;
 - h. Condition at bottom;
 - i. Diameter and length of casing;
 - j. Reinforcing used.

- B. The Contractor shall allow for a minimum of 2 days notice to be given the laboratory for the inspection work.

3.03 CONCRETE REINFORCEMENT TESTING AND INSPECTION

- A. Reinforcing Bar Inspection: Inspect reinforcing bar placement including size, number, configuration, locations, clearances, and related criteria.
- B. Reinforcing: Inspect all reinforcing steel prior to placement of concrete for compliance with the Contract Documents and the approved shop drawings. All instances of noncompliance shall be immediately brought to the attention of the Contractor. If uncorrected by the contractor, they shall be listed in the report.
 - 1. Observe and report the following: number and size of bars; bending; splicing; clearance to forms; clearance between bars; rust, from oil or other contamination; fabrication and installation of embedded metal assemblies, including visual inspection of all welds.
- C. Inspector shall have a minimum of three years experience inspecting reinforcing steel in projects of similar size.

3.04 CAST-IN-PLACE CONCRETE TESTING AND INSPECTION

- A. Materials and operations shall be tested and inspected as work progresses. Failure to detect defective work shall not prevent rejection when defect is discovered, nor shall it obligate the Architect for final acceptance.
- B. Testing agencies shall meet the requirements of "Recommended Practice for Inspection and Testing Agencies for Concrete and Steel in Construction", ASTM E-329-70.
- C. The following review and testing services shall be performed by the designated laboratory:
 - 1. The testing laboratory shall review the submitted mix designs for conformance with "Building Code Requirements for Structural Concrete" ACI 318-95.
 - 2. Secure composite samples in accordance with "Method of Sampling Fresh Concrete" ASTM C172, Current Edition.
 - 3. Mold and cure five specimens from each sample in accordance with "Method of Making and Curing Concrete Compression and Flexural Specimens in the Field", ASTM C31, Current Edition.
 - 4. Test specimens in accordance with "Method of Test for Compressive Strength of Molded Concrete Cylinders", ASTM C39, Current Edition. Two specimens shall be tested at 28 days for acceptance and two shall be tested at 7 days for information. The remaining cylinder shall be tested as directed.
 - 5. Make one strength test for each 100 cubic yards or fraction thereof, of each mix design or concrete placed in any one day.
 - 6. Determine slump for each strength test and whenever consistency of concrete appears to vary, using "Method of Test for Slump of Portland Cement Concrete" ASTM C143, Current Edition and air content of normal weight or light weight concrete sample for each strength test.
 - 7. Determine temperature of concrete sample for each strength test.
 - 8. Other testing services needed or required shall be paid by the Contractor.
 - 9. Inspect and control the concrete mixing and loading of transit-mix trucks at the plant at the start of each day's mixing. Check mixing from mixers before mix begins to set and within time limits set forth in ASTM C94. Prevailing conditions shall be compared to the criteria indicated on the appropriate design mix (temperature, moisture, condition of aggregates, etc.).
 - 10. Any significant deviance shall be immediately reported to the Architect and the design laboratory and corresponding adjustments to the mix made before any materials are discharged.

11. Control the addition of water to the concrete at the job site and the length of time the concrete is allowed to remain in the truck during the pour.
 12. Specimens for pumped concrete shall be taken at the discharge and of pumping equipment.
 13. Certify each delivery ticket indicating class of concrete delivered (or poured), amount of water added and the time at which the cement and aggregate was discharged into the truck, and the time at which the concrete was discharged from the truck.
- D. Provide and maintain for the use of the testing agency adequate facilities for proper curing of concrete test specimens on the project site in accordance with "Methods of Making and Curing Concrete Compression and Flexural Specimens in the Field" ASTM C31, Current Edition.
- E. Evaluation and Acceptance:
1. The strength level of the concrete will be considered satisfactory if 90% of the strength test results and the averages of all sets of three consecutive strength test results equal or exceed specified strength and no individual test result is below specified strength by more than 500 psi.
 2. Completed concrete work will be accepted when the requirements of "Specifications for Structural Concrete for Buildings" ACI 301-84, Chapter 18 have been complied with.
 3. In any case, where the average strength of the laboratory control cylinders, as shown by the tests for any portion of the structure, falls below the minimum ultimate compressive strength hereinbefore specified, the Architect shall have the right to require the Contractor to provide improved curing conditions of temperature and moisture to secure the required strength. Also, if the average strength of the laboratory control cylinders should fall so low as to cause the portions of the structure to which the respective unsatisfactory test reports apply to be in question by the Architect, the Contractor shall follow the core procedure set forth in the current edition of ASTM Designation C42. If the results of the core tests indicate, in the opinion of the Architect, that the strength of the structure is inadequate, such replacement, load testing, or strengthening as may be ordered by the Architect shall be provided by the Contractor without cost to the Owner.
 4. The testing laboratory shall control field adjustments made to concrete mixes to compensate for field conditions and report same.
 5. Wherever the testing laboratory recognizes a trend of decreasing quality in the concrete due to changing reasons, conditions of curing or other cause; this shall be brought to the attention of the Architect, along with a recommendation for corrective action to be taken before the materials fall below the requirements of these Specifications.
- F. Reports: In addition, the testing laboratory shall make one copy of the reports to the concrete supplier.

3.05 MASONRY MORTAR AND GROUTS

- A. Check mix designs for mortar and grouts. Make tests of mortar and grout to approval for use at project site. Perform four (4) tests in accordance with ASTM C39 for each twenty-five (25) cubic yards of mortar.
- B. Submit an additional copy of the laboratory reports to the steel supplier.
- C. Compressive Test for Grout:
1. Secure composite samples of grout at the job site in accordance with ASTM C172.
 2. Mold and cure three, 3" diameter by 6" tall cylinders from each sample in accordance with ASTM C31. Supervise the curing protection provided by the contractor for the test specimens in the field and transportation to the laboratory. The test cylinders shall be stored in the field 24 hours and then moved to the laboratory and cured in accordance with ASTM C31.

3. Test specimens in accordance with ASTM C39. Two test specimens shall be tested at 28 days for acceptance and one shall be tested at seven days for information.
4. Make one strength test (three cylinders) for each five cubic yards of grout placed, but not less than one strength test for each 5000 square feet of wall area.

3.06 INSPECTING STRUCTURAL STEEL

- A. Field Inspection
 1. Proper erection of all pieces.
 2. Proper installation of all bolts, including checking the calibration of impact wrenches used with high strength bolts.
 3. Plumbness of structure and proper bracing.
 4. Ultrasonic inspection of all full penetration welds.
 5. Record and measure camber of beams upon arrival and before erection with compliance with the specified camber. Measure beam lying flat with web in the horizontal position. Members outside the specified camber tolerance shall be returned to the shop.
- B. Qualification of Welders: Before assigning any welder to work covered by this section of the Specifications, the fabricator shall provide the Testing Laboratory with certification that each of the welders to be employed on the project has passed qualification tests within the last year using procedures covered in the American Welding Society Standard D1.0-63.
- C. The contractor shall be responsible for furnishing fabrication and erection inspection and testing of all welds in accordance with AWS D1.1, Chapter 6. Submit records of inspections and tests to the Owner's testing laboratory for their review.
- D. Inspection of shop and field welding shall be "verification inspection" in accordance with Section 6 of AWS D1.1 and as follows:
 1. Visually inspect the welding of all shop fabricated members and note the location of all cover plates, connectors, bearing stiffeners, splices, and fillet welds for proper return around ends and check for seams, folds, and delamination.
 2. Ultrasonically test all full penetration welds in accordance with ASTM E164.
 3. Root passes shall be thoroughly inspected for cracks. All cracks shall be gouged out and rewelded to two inches beyond each end of the crack.
 4. Mark all welds requiring repairs and make reinspections.
 5. The Testing Laboratory inspector shall advise the Owner and Architect of any shop and/or field conditions which, in his opinion, may require further tests and examination. Such further tests shall be performed as authorized by the Owner and Architect.
 6. The Owner reserves the right to use ultrasonic or radiographic inspection to verify the adequacy of all welds. Testing procedures and acceptance criteria shall be as specified in AWS D1.1.
- E. Inspection of bolted construction shall be in accordance with AISC "Specification for Structural Steel Buildings" and as follows:
 1. All bolts shall be visually inspected to ensure that the plies have been brought into "snug" contact.
 2. High strength bolts shall be inspected in accordance with Section 9 of the AISC "Specifications for Structural Joints Using ASTM A325 or A490 Bolts." Bolts are to be fully torqued as required by the AISC specification.
 3. For all high strength bolts, the inspector shall observe the required jobsite testing and calibration, and shall confirm that the procedure to be used provides the required tension.

3.07 INSPECTION OF OPEN WEB STEEL JOIST

- A. Inspect all joists upon arrival to the jobsite for conformance with the specified fabrication requirements. Check welded connections between web and chords, splices, and straightness of members.
- B. Inspect installation of joists at the jobsite. Check connections to supporting members, chord extensions, number of rows of bridging, and bridging connections for conformance to the Contract Documents and the shop drawings.
- C. Check welder's certificates for field welding procedures.

3.08 INSPECTION OF METAL DECK

- A. Field Inspection shall consist of the following:
 - 1. Check types, gauges and finishes for conformance with the Contract Documents and shop drawings.
 - 2. Examination of proper erection of all metal deck, fastenings, reinforcing of holes, miscellaneous deck supports, hanger tabs, shear studs, and deck closures.
 - 3. Check welder's certificates.
 - 4. Visual inspection of all welds.

3.09 INSPECTION OF COLD FORMED METAL FRAMING

- A. Field Inspection shall consist of the following:
 - 1. Check types, gauges and finishes for conformance with the Contract Documents and shop drawings.
 - 2. Examination of proper erection of all framing, fastenings, connections and miscellaneous supports.
 - 3. Check welder's certificates.
 - 4. Visual inspection of all field and shop welds.

3.10 REPAIR AND PROTECTION

- A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
 - 1. Provide materials and comply with installation requirements specified in other Sections of these Specifications. Restore patched areas and extend restoration into adjoining areas in a manner that eliminates evidence of patching.
 - 2. Retain subparagraph above or below. Above is for simple projects that do not include a "Cutting and Patching" Section and relies on patching and repair materials being the same as for new construction.
 - 3. Comply with the Contract Document requirements for Division 1 Section - Cutting and Patching.
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 01 40 00

SECTION 01 42 00 - REFERENCE STANDARDS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."
- D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."
- E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
- H. "Provide": Furnish and install, complete and ready for the intended use.
- I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built. Refer to Division 01 "Work Restrictions".

1.03 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
- C. Conflicting Requirements: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to Architect for a decision before proceeding.
 - 1. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are

minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

- D. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.04 ABBREVIATIONS AND ACRONYMS

- A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.
1. Where abbreviations and acronyms used in Specifications or other Contract Documents are not listed, they shall mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States."

AABC	Associated Air Balance Council www.aabc.com	(202) 737-0202
AAMA	American Architectural Manufacturers Association www.aamanet.org	(847) 303-5664
AASHTO	American Association of State Highway and Transportation Officials www.transportation.org	(202) 624-5800
AATCC	American Association of Textile Chemists and Colorists www.aatcc.org	(919) 549-8141
ABMA	American Bearing Manufacturers Association www.americanbearings.org	(202) 367-1155
ACI	American Concrete Institute (Formerly: ACI International) www.concrete.org	(248) 848-3700
ACPA	American Concrete Pipe Association www.concrete-pipe.org	(972) 506-7216
AEIC	Association of Edison Illuminating Companies, Inc. (The) www.aeic.org	(205) 257-2530
AF&PA	American Forest & Paper Association www.afandpa.org	(800) 878-8878 (202) 463-2700
AGA	American Gas Association www.aga.org	(202) 824-7000
AHAM	Association of Home Appliance Manufacturers www.aham.org	(202) 872-5955
AHRI	Air-Conditioning, Heating, and Refrigeration Institute (The) www.ahrinet.org	(703) 524-8800
AI	Asphalt Institute www.asphaltinstitute.org	(859) 288-4960
AIA	American Institute of Architects (The) www.aia.org	(800) 242-3837 (202) 626-7300
AISC	American Institute of Steel Construction www.aisc.org	(800) 644-2400 (312) 670-2400
AISI	American Iron and Steel Institute www.steel.org	(202) 452-7100
AITC	American Institute of Timber Construction www.aitc-glulam.org	(303) 792-9559

AMCA	Air Movement and Control Association International, Inc. www.amca.org	(847) 394-0150
ANSI	American National Standards Institute www.ansi.org	(202) 293-8020
AOSA	Association of Official Seed Analysts, Inc. www.aosaseed.com	(607) 256-3313
APA	APA - The Engineered Wood Association www.apawood.org	(253) 565-6600
APA	Architectural Precast Association www.archprecast.org	(239) 454-6989
API	American Petroleum Institute www.api.org	(202) 682-8000
ARI	Air-Conditioning & Refrigeration Institute (See AHRI)	
ARI	American Refrigeration Institute (See AHRI)	
ARMA	Asphalt Roofing Manufacturers Association www.asphaltroofing.org	(202) 207-0917
ASCE	American Society of Civil Engineers www.asce.org	(800) 548-2723 (703) 295-6300
ASCE/SEI	American Society of Civil Engineers/Structural Engineering Institute (See ASCE)	
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers www.ashrae.org	(800) 527-4723 (404) 636-8400
ASME	ASME International (American Society of Mechanical Engineers) www.asme.org	(800) 843-2763 (973) 882-1170
ASSE	American Society of Safety Engineers (The) www.asse.org	(847) 699-2929
ASSE	American Society of Sanitary Engineering www.asse-plumbing.org	(440) 835-3040
ASTM	ASTM International (American Society for Testing and Materials International) www.astm.org	(610) 832-9500
ATIS	Alliance for Telecommunications Industry Solutions www.atis.org	(202) 628-6380
AWEA	American Wind Energy Association www.awea.org	(202) 383-2500
AWI	Architectural Woodwork Institute www.awinet.org	(571) 323-3636
AWMAC	Architectural Woodwork Manufacturers Association of Canada www.awmac.com	(403) 453-7387
AWPA	American Wood Protection Association (Formerly: American Wood-Preservers' Association) www.awpa.com	(205) 733-4077
AWS	American Welding Society www.aws.org	(800) 443-9353 (305) 443-9353
AWWA	American Water Works Association www.awwa.org	(800) 926-7337 (303) 794-7711
BHMA	Builders Hardware Manufacturers Association www.buildershardware.com	(212) 297-2122
BIA	Brick Industry Association (The) www.gobrick.com	(703) 620-0010
BICSI	BICSI, Inc. www.bicsi.org	(800) 242-7405 (813) 979-1991

BIFMA	BIFMA International (Business and Institutional Furniture Manufacturer's Association) www.bifma.com	(616) 285-3963
BISSC	Baking Industry Sanitation Standards Committee www.bissc.org	(866) 342-4772
BWF	Badminton World Federation (Formerly: International Badminton Federation) www.bwfbadminton.org	60 3 9283 7155
CDA	Copper Development Association www.copper.org	(800) 232-3282 (212) 251-7200
CEA	Consumer Electronics Association www.ce.org	(866) 858-1555 (703) 907-7600
CFFA	Chemical Fabrics & Film Association, Inc. www.chemicalfabricsandfilm.com	(216) 241-7333
CFSEI	Cold-Formed Steel Engineers Institute www.cfsei.org	(866) 465-4732 (202) 263-4488
CGA	Compressed Gas Association www.cganet.com	(703) 788-2700
CIMA	Cellulose Insulation Manufacturers Association www.cellulose.org	(888) 881-2462 (937) 222-2462
CISCA	Ceilings & Interior Systems Construction Association www.cisca.org	(630) 584-1919
CISPI	Cast Iron Soil Pipe Institute www.cispi.org	(404) 622-0073
CLFMI	Chain Link Fence Manufacturers Institute www.chainlinkinfo.org	(301) 596-2583
CPA	Composite Panel Association www.pbmdf.com	(703) 724-1128
CRI	Carpet and Rug Institute (The) www.carpet-rug.org	(706) 278-3176
CRRC	Cool Roof Rating Council www.coolroofs.org	(866) 465-2523 (510) 485-7175
CRSI	Concrete Reinforcing Steel Institute www.crsi.org	(800) 328-6306 (847) 517-1200
CSA	CSA International (Formerly: IAS - International Approval Services) www.csa-international.org	(866) 797-4272 (416) 747-4000
CSI	Construction Specifications Institute (The) www.csinet.org	(800) 689-2900 (703) 684-0300
CSSB	Cedar Shake & Shingle Bureau www.cedarbureau.org	(604) 820-7700
CTI	Cooling Technology Institute (Formerly: Cooling Tower Institute) www.cti.org	(281) 583-4087
CWC	Composite Wood Council (See CPA)	
DASMA	Door and Access Systems Manufacturers Association www.dasma.com	(216) 241-7333
DHI	Door and Hardware Institute www.dhi.org	(703) 222-2010
ECA	Electronic Components Association www.ec-central.org	(703) 907-8024
ECAMA	Electronic Components Assemblies & Materials Association (See ECA)	
EIA	Electronic Industries Alliance (See TIA)	

EIMA	EIFS Industry Members Association www.eima.com	(800) 294-3462 (703) 538-1616
EJMA	Expansion Joint Manufacturers Association, Inc. www.ejma.org	(914) 332-0040
ESD	ESD Association (Electrostatic Discharge Association) www.esda.org	(315) 339-6937
ESTA	Entertainment Services and Technology Association (See PLASA)	
EVO	Efficiency Valuation Organization www.evo-world.org	(415) 367-3643 44 20 88 167 857
FM Approvals	FM Approvals LLC www.fmglobal.com	(781) 762-4300
FM Global	FM Global (Formerly: FMG - FM Global) www.fmglobal.com	(401) 275-3000
FRSA	Florida Roofing, Sheet Metal & Air Conditioning Contractors Association, Inc. www.floridarooft.com	(407) 671-3772
FSA	Fluid Sealing Association www.fluidsealing.com	(610) 971-4850
FSC	Forest Stewardship Council U.S. www.fscus.org	(612) 353-4511
GA	Gypsum Association www.gypsum.org	(301) 277-8686
GANA	Glass Association of North America www.glasswebsite.com	(785) 271-0208
GS	Green Seal www.greenseal.org	(202) 872-6400
HI	Hydraulic Institute www.pumps.org	(973) 267-9700
HI/GAMA	Hydronics Institute/Gas Appliance Manufacturers Association (See AHRI)	
HMMA	Hollow Metal Manufacturers Association (See NAAMM)	
HPVA	Hardwood Plywood & Veneer Association www.hpva.org	(703) 435-2900
HPW	H. P. White Laboratory, Inc. www.hpwhite.com	(410) 838-6550
IAPSC	International Association of Professional Security Consultants www.iapsc.org	(415) 536-0288
IAS	International Approval Services (See CSA)	
ICBO	International Conference of Building Officials (See ICC)	
ICC	International Code Council www.iccsafe.org	(888) 422-7233 (202) 370-1800
ICEA	Insulated Cable Engineers Association, Inc. www.icea.net	(770) 830-0369
ICPA	International Cast Polymer Alliance www.icpa-hq.org	(703) 525-0511
ICRI	International Concrete Repair Institute, Inc. www.icri.org	(847) 827-0830
IEC	International Electrotechnical Commission www.iec.ch	41 22 919 02 11
IEEE	Institute of Electrical and Electronics Engineers, Inc. (The) www.ieee.org	(212) 419-7900

IES	Illuminating Engineering Society (Formerly: Illuminating Engineering Society of North America) www.ies.org	(212) 248-5000
IESNA	Illuminating Engineering Society of North America (See IES)	
IEST	Institute of Environmental Sciences and Technology www.iest.org	(847) 981-0100
IGMA	Insulating Glass Manufacturers Alliance www.igmaonline.org	(613) 233-1510
IGSHPA	International Ground Source Heat Pump Association www.igshpa.okstate.edu	(405) 744-5175
Intertek	Intertek Group (Formerly: ETL SEMCO; Intertek Testing Service NA) www.intertek.com	(800) 967-5352
ISA	International Society of Automation (The) (Formerly: Instrumentation, Systems, and Automation Society) www.isa.org	(919) 549-8411
ISAS	Instrumentation, Systems, and Automation Society (The) (See ISA)	
ISFA	International Surface Fabricators Association (Formerly: International Solid Surface Fabricators Association) www.isfanow.org	(877) 464-7732 (801) 341-7360
ISO	International Organization for Standardization www.iso.org	41 22 749 01 11
ISSFA	International Solid Surface Fabricators Association (See ISFA)	
ITU	International Telecommunication Union www.itu.int/home	41 22 730 51 11
KCMA	Kitchen Cabinet Manufacturers Association www.kcma.org	(703) 264-1690
LMA	Laminating Materials Association (See CPA)	
LPI	Lightning Protection Institute www.lightning.org	(800) 488-6864
MBMA	Metal Building Manufacturers Association www.mbma.com	(216) 241-7333
MCA	Metal Construction Association www.metalconstruction.org	(847) 375-4718
MFMA	Maple Flooring Manufacturers Association, Inc. www.maplefloor.org	(888) 480-9138
MFMA	Metal Framing Manufacturers Association, Inc. www.metalframingmfg.org	(312) 644-6610
MHIA	Material Handling Industry of America www.mhia.org	(800) 345-1815 (704) 676-1190
MIA	Marble Institute of America www.marble-institute.com	(440) 250-9222
MMPA	Moulding & Millwork Producers Association (Formerly: Wood Moulding & Millwork Producers Association) www.wmmpa.com	(800) 550-7889 (530) 661-9591
MPI	Master Painters Institute www.paintinfo.com	(888) 674-8937 (604) 298-7578
MSS	Manufacturers Standardization Society of The Valve and Fittings Industry Inc. www.mss-hq.org	(703) 281-6613
NAAMM	National Association of Architectural Metal Manufacturers	(630) 942-6591

NACE	www.naamm.org NACE International (National Association of Corrosion Engineers International) www.nace.org	(800) 797-6223 (281) 228-6200
NADCA	National Air Duct Cleaners Association www.nadca.com	(202) 737-2926
NAIMA	North American Insulation Manufacturers Association www.naima.org	(703) 684-0084
NBGQA	National Building Granite Quarries Association, Inc. www.nbgqa.com	(800) 557-2848
NCAA	National Collegiate Athletic Association (The) www.ncaa.org	(317) 917-6222
NCMA	National Concrete Masonry Association www.ncma.org	(703) 713-1900
NEBB	National Environmental Balancing Bureau www.nebb.org	(301) 977-3698
NECA	National Electrical Contractors Association www.necanet.org	(301) 657-3110
NeLMA	Northeastern Lumber Manufacturers Association www.nelma.org	(207) 829-6901
NEMA	National Electrical Manufacturers Association www.nema.org	(703) 841-3200
NETA	InterNational Electrical Testing Association www.netaworld.org	(888) 300-6382 (269) 488-6382
NFHS	National Federation of State High School Associations www.nfhs.org	(317) 972-6900
NFPA	NFPA (National Fire Protection Association) www.nfpa.org	(800) 344-3555 (617) 770-3000
NFRC	National Fenestration Rating Council www.nfrc.org	(301) 589-1776
NHLA	National Hardwood Lumber Association www.nhla.com	(800) 933-0318 (901) 377-1818
NLGA	National Lumber Grades Authority www.nlga.org	(604) 524-2393
NOFMA	National Oak Flooring Manufacturers Association (See NWFA)	
NOMMA	National Ornamental & Miscellaneous Metals Association www.nomma.org	(888) 516-8585
NRCA	National Roofing Contractors Association www.nrca.net	(800) 323-9545 (847) 299-9070
NRMCA	National Ready Mixed Concrete Association www.nrmca.org	(888) 846-7622 (301) 587-1400
NSF	NSF International (National Sanitation Foundation International) www.nsf.org	(800) 673-6275 (734) 769-8010
NSPE	National Society of Professional Engineers www.nspe.org	(703) 684-2800
NSSGA	National Stone, Sand & Gravel Association www.nssga.org	(800) 342-1415 (703) 525-8788
NTMA	National Terrazzo & Mosaic Association, Inc. (The) www.ntma.com	(800) 323-9736
NWFA	National Wood Flooring Association www.nwfa.org	(800) 422-4556 (636) 519-9663
PCI	Precast/Prestressed Concrete Institute www.pci.org	(312) 786-0300
PDI	Plumbing & Drainage Institute	(800) 589-8956

PLASA	www.pdionline.org	(978) 557-0720
	PLASA (Formerly: ESTA - Entertainment Services and Technology Association)	(212) 244-1505
RCSC	www.plasa.org	
	Research Council on Structural Connections	
RFCI	www.boltcouncil.org	
	Resilient Floor Covering Institute	(706) 882-3833
RIS	www.rfci.com	
	Redwood Inspection Service	(925) 935-1499
SAE	www.redwoodinspection.com	
	SAE International (Society of Automotive Engineers)	(877) 606-7323 (724) 776-4841
SBCCI	www.sae.org	
	Southern Building Code Congress International, Inc. (See ICC)	
SCTE	Society of Cable Telecommunications Engineers	(800) 542-5040
	www.scte.org	(610) 363-6888
SDI	Steel Deck Institute	(847) 458-4647
	www.sdi.org	
SDI	Steel Door Institute	(440) 899-0010
	www.steeldoor.org	
SEFA	Scientific Equipment and Furniture Association	(877) 294-5424
	www.sefalabs.com	(516) 294-5424
SEI/ASCE	Structural Engineering Institute/American Society of Civil Engineers	
	(See ASCE)	
SIA	Security Industry Association	(866) 817-8888
	www.siaonline.org	(703) 683-2075
SJI	Steel Joist Institute	(843) 293-1995
	www.steeljoist.org	
SMA	Screen Manufacturers Association	(773) 636-0672
	www.smainfo.org	
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association	(703) 803-2980
	www.smacna.org	
SMPTE	Society of Motion Picture and Television Engineers	(914) 761-1100
	www.smpte.org	
SPFA	Spray Polyurethane Foam Alliance	(800) 523-6154
	www.sprayfoam.org	
SPIB	Southern Pine Inspection Bureau	(850) 434-2611
	www.spib.org	
SPRI	Single Ply Roofing Industry	(781) 647-7026
	www.spri.org	
SRCC	Solar Rating and Certification Corporation	(321) 638-1537
	www.solar-rating.org	
SSINA	Specialty Steel Industry of North America	(800) 982-0355
	www.ssina.com	(202) 342-8630
SSPC	SSPC: The Society for Protective Coatings	(877) 281-7772
	www.sspc.org	(412) 281-2331
STI	Steel Tank Institute	(847) 438-8265
	www.steeltank.com	
SWI	Steel Window Institute	(216) 241-7333
	www.steelwindows.com	
SWPA	Submersible Wastewater Pump Association	(847) 681-1868
	www.swpa.org	
TCA	Tilt-Up Concrete Association	(319) 895-6911
	www.tilt-up.org	

TCA	Tile Council of America (See TCNA)	
TCNA	Tile Council of North America, Inc. (Formerly: Tile Council of America) www.tileusa.com	(864) 646-8453
TEMA	Tubular Exchanger Manufacturers Association, Inc. www.tema.org	(914) 332-0040
TIA	Telecommunications Industry Association (Formerly: TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance) www.tiaonline.org	(703) 907-7700
TIA/EIA	Telecommunications Industry Association/Electronic Industries Alliance (See TIA)	
TMS	The Masonry Society www.masonrysociety.org	(303) 939-9700
TPI	Truss Plate Institute www.tpinst.org	(703) 683-1010
TPI	Turfgrass Producers International www.turfgrasssod.org	(800) 405-8873 (847) 649-5555
TRI	Tile Roofing Institute www.tilerroofing.org	(312) 670-4177
UBC	Uniform Building Code (See ICC)	
UL	Underwriters Laboratories Inc. www.ul.com	(877) 854-3577
UNI	Uni-Bell PVC Pipe Association www.uni-bell.org	(972) 243-3902
USAV	USA Volleyball www.usavolleyball.org	(888) 786-5539 (719) 228-6800
USGBC	U.S. Green Building Council www.usgbc.org	(800) 795-1747
USITT	United States Institute for Theatre Technology, Inc. www.usitt.org	(800) 938-7488 (315) 463-6463
WASTEC	Waste Equipment Technology Association www.wastec.org	(800) 424-2869 (202) 244-4700
WCLIB	West Coast Lumber Inspection Bureau www.wclib.org	(800) 283-1486 (503) 639-0651
WCMA	Window Covering Manufacturers Association www.wcmanet.org	(212) 297-2122
WDMA	Window & Door Manufacturers Association www.wdma.com	(800) 223-2301 (312) 321-6802
WI	Woodwork Institute (Formerly: WIC - Woodwork Institute of California) www.wicnet.org	(916) 372-9943
WMMPA	Wood Moulding & Millwork Producers Association (See MMPA)	
WSRCA	Western States Roofing Contractors Association www.wsrca.com	(800) 725-0333 (650) 938-5441
WWPA	Western Wood Products Association www.wwpa.org	(503) 224-3930

B. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

DIN	Deutsches Institut für Normung e.V.	49 30 2601-0

IAPMO	www.din.de International Association of Plumbing and Mechanical Officials www.iapmo.org	(909) 472-4100
ICC	International Code Council www.iccsafe.org	(888) 422-7233
ICC-ES	ICC Evaluation Service, LLC www.icc-es.org	(800) 423-6587 (562) 699-0543

C. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

COE	Army Corps of Engineers www.usace.army.mil	(202) 761-0011
CPSC	Consumer Product Safety Commission www.cpsc.gov	(800) 638-2772 (301) 504-7923
DOC	Department of Commerce National Institute of Standards and Technology www.nist.gov	(301) 975-4040
DOD	Department of Defense http://dodssp.daps.dla.mil	(215) 697-2664
DOE	Department of Energy www.energy.gov	(202) 586-9220
EPA	Environmental Protection Agency www.epa.gov	(202) 272-0167
FAA	Federal Aviation Administration www.faa.gov	(866) 835-5322
FG	Federal Government Publications www.gpo.gov	(202) 512-1800
GSA	General Services Administration www.gsa.gov	(800) 488-3111 (202) 619-8925
HUD	Department of Housing and Urban Development www.hud.gov	(202) 708-1112
LBL	Lawrence Berkeley National Laboratory Environmental Energy Technologies Division http://eetd.lbl.gov	(510) 486-4000
OSHA	Occupational Safety & Health Administration www.osha.gov	(800) 321-6742
TRB	Transportation Research Board National Cooperative Highway Research Program www.trb.org	(202) 334-2934
USDA	Department of Agriculture Rural Utilities Service www.usda.gov	(202) 720-2791
USDJ	Department of Justice Office of Justice Programs National Institute of Justice www.ojp.usdoj.gov	(202) 307-0703
USP	U.S. Pharmacopeia www.usp.org	(800) 227-8772 (301) 881-0666
USPS	United States Postal Service www.usps.com	(202) 268-2000

D. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and

regulations in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

ABA /	Architectural Barriers Act	(800) 872-2253
ADA /	Americans with Disabilities Act	
ADAAG	Americans with Disabilities Act Accessibility Guidelines <i>Administered by the United States Access Board</i> http://www.access-board.gov/	
CFR	Code of Federal Regulations	(866) 512-1800
	Available from Government Printing Office	(202) 512-1800
	www.gpo.gov/fdsys	
DOD	Department of Defense	(215) 697-2664
	Military Specifications and Standards	
	Available from Department of Defense Single Stock Point	
	http://dodssp.daps.dla.mil	
FED-STD	Federal Standard (See FS)	
FS	Federal Specification	(215) 697-2664
	Available from Department of Defense Single Stock Point	
	http://dodssp.daps.dla.mil	
	Available from Defense Standardization Program	
	www.dsp.dla.mil	
	Available from General Services Administration	(800) 488-3111
	www.gsa.gov	(202) 619-8925
	Available from National Institute of Building Sciences/Whole Building Design Guide	(202) 289-7800
	www.wbdg.org/ccb	
MILSPEC	Military Specification and Standards (See DOD)	
TAS	Texas Accessibility Standards	(512) 539 5669
	<i>Administered by the Texas Department of Licensing and Registration</i>	
	http://www.tdlr.texas.gov/ab/ab.htm	
UFAS	Uniform Federal Accessibility Standards	(800) 872-2253
	<i>Administered by the United States Access Board</i>	
	http://www.access-board.gov/guidelines-and-standards/buildings-and-sites/about-the-aba-standards/ufas	
USAB	United States Access Board	(800) 872-2253
	www.access-board.gov	(202) 272-0080
USATBCB	U.S. Architectural & Transportation Barriers Compliance Board (See USAB)	

E. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

CBHF	State of California	(800) 952-5210
	Department of Consumer Affairs	(916) 574-2041
	Bureau of Electronic Appliance and Repair, Home Furnishings and Thermal Insulation	
	www.bearhfti.ca.gov	
CCR	California Code of Regulations	(916) 323-6225
	Office of Administrative Law	
	California Title 24 Energy Code	
	www.calregs.com	
CDHS	California Department of Health Care Services	

	(Formerly: California Department of Health Services) (See CCR)	
CDPH	California Department of Public Health Indoor Air Quality Program www.cal-iaq.org	
CPUC	California Public Utilities Commission www.cpuc.ca.gov	(800) 848-5580 (415) 703-2782
SCAQMD	South Coast Air Quality Management District www.aqmd.gov	(909) 396-2000
TCEQ	Texas Commission on Environmental Quality http://www.tceq.state.tx.us/	(512) 239-1000
TDLR	Texas Department of Licensing and Registration http://www.tdlr.texas.gov/index.htm	(800) 803-9202
TFS	Texas Forest Service Forest Resource Development and Sustainable Forestry http://txforests-service.tamu.edu	(979) 458-6606
TxDOT	Texas Department of Transportation www.txdot.gov	(800) 558-9368

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 42 00

SECTION 01 43 39 - MOCKUPS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. General requirements for mockups specified in other technical Sections.
- B. General Coordination Procedures, (Reference Specification Section 01 31 00) General Contractor shall coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work that depend on each other for proper installation, connection, and operation.

1.02 DEFINITIONS

- A. Mockups: Full-size physical assemblies that are constructed on-site. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and, where indicated, qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.
- B. Integrated Exterior Mockups: Mockups of the exterior envelope erected separately from the building but on Project site, consisting of multiple products, assemblies, and subassemblies.

1.03 SUBMITTALS

- A. Mockup Shop Drawings: For integrated exterior wall and roofing mockups and integrated mockups of interior assemblies and finishes
 - 1. Provide plans, sections, and elevations, indicating materials and size of mockup construction.
 - 2. Indicate manufacturer and model number of individual components.
 - 3. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.

1.04 MOCKUPS

- A. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
 - 1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.
 - 2. Notify Architect 7 days in advance of dates and times when mockups will be constructed.
 - 3. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed during the construction at Project.
 - 4. Demonstrate the proposed range of aesthetic effects and workmanship.
 - 5. Obtain Architect's approval of mockups before starting work, fabrication, or construction.
 - a. Allow 7 days for initial review and each re-review of each mockup.
 - 6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 - 7. Demolish and remove mockups when directed unless otherwise indicated.
- B. Mockup Pre-Installation Conference: Before beginning mock-up construction and installation, conduct conference with manufacturer's representatives, fabricators, installers, Architect, Owner

and other interested parties to review procedures, schedules, and coordination of curtain wall installation with other elements of Work.

- C. Approved Mockups:
 - 1. Maintain approved in-place mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 - a. Approved mock-up assemblies built in-place may remain as part of final Work.
 - 2. Maintain approved stand-alone mockup; do not disassemble or dispose of until so directed by Architect.
 - a. Demolish and remove stand-alone mockups when directed, unless otherwise indicated.
- D. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 - 1. Approved mock-up assemblies built in-place may remain as part of final Work.
 - 2. Demolish and remove mock-ups when directed, unless otherwise indicated.
 - 3. Mock-up shall remain on site and shall not be removed, disassembled, or disposed of until so directed by Architect.

PART 2 - PRODUCTS

Not Used.

PART 3 - MOCKUP SCHEDULE

3.01 INTEGRATED EXTERIOR WALL MOCKUP

- A. General: Construct integrated exterior mockup according to approved Mockup Shop Drawings. Coordinate installation of exterior envelope materials and products for which mockups are required in individual Specification Sections, along with other supporting materials.
- B. Mockup Shop Drawings and Mockup Pre-Installation Conference: As specified herein.
- C. Size: As indicated on approved Mockup Shop Drawings, and as follows:
 - 1. Width: 8'-0" wide, minimum.
 - 2. Height: Minimum truncated height required to include all elements of full-height wall.
- D. Scope: Construct integrated mockup of partial exterior wall and roofing systems as indicated on the drawings and/or as specified. Mockup to include but not limited to the following wall assembly elements:
 - 1. Back-Up Structure: Light-gage steel back-up wall, including the following:
 - a. Fiberglass-faced gypsum sheathing
 - b. Continuous air barrier, tie-in to other components.
 - c. Insulation
 - d. Through-wall flashing and weeps.
 - 2. Masonry Veneer: Including the following:
 - a. Limestone veneer, pigmented mortar joints, ashlar pattern.
 - b. Sealant joints
 - c. Cast stone sill
 - 3. Glazed Opening: Including the following:
 - a. Aluminum storefront framing, anchors and flashing.
 - b. Glass and glazing materials.
 - c. Sealant joints
 - d. Field-Testing: For air and water infiltration, in accordance with Division 01 requirements.

3.02 OTHER MOCKUPS

- A. In addition to previous items, construct field (project site) mock-ups and samples for review where indicated in individual Specifications Sections.

3.03 INSTALLATION

- A. Installation: Construct mock-ups for Architect's visual examination, for quality control, and performance of required testing. Use materials, fabrication and installation methods identical with those indicated for Work. Simulate surrounding conditions as closely as possible.
 - 1. Construct mockups for Architect's visual examination, for quality control and quality of installation.
 - a. Demonstrate the proposed range of aesthetic effects and workmanship.
 - b. Build mockups of size indicated in Drawings.
 - c. Use materials, fabrication and installation methods identical with those indicated for Work.
 - d. Simulate surrounding conditions as closely as possible.
 - 2. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed during the construction at Project.
 - 3. Install mockups under manufacturer's direct supervision employing workmen who will be used during actual erection at job site.

END OF SECTION 01 43 39

SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes requirements for temporary facilities and controls, including temporary utilities, support facilities, and security and protection facilities.
- B. Temporary utilities include, but are not limited to, the following:
 - 1. Sewers and drainage.
 - 2. Water service and distribution.
 - 3. Sanitary facilities, including toilets, wash facilities, and drinking-water facilities.
 - 4. Heating and cooling facilities.
 - 5. Ventilation.
 - 6. Electric power service.
 - 7. Lighting.
 - 8. Telephone service.
- C. Support facilities include, but are not limited to, the following:
 - 1. Temporary roads and paving.
 - 2. Dewatering facilities and drains.
 - 3. Project identification and temporary signs.
 - 4. Waste disposal facilities.
 - 5. Field offices.
 - 6. Storage and fabrication sheds.
 - 7. Lifts and hoists.
 - 8. Temporary elevator usage.
 - 9. Temporary stairs.
 - 10. Construction aids and miscellaneous services and facilities.
- D. Security and protection facilities include, but are not limited to, the following:
 - 1. Environmental protection.
 - 2. Stormwater control.
 - 3. Tree and plant protection.
 - 4. Pest control.
 - 5. Site enclosure fence.
 - 6. Security enclosure and lockup.
 - 7. Barricades, warning signs, and lights.
 - 8. Covered walkways.
 - 9. Temporary enclosures.
 - 10. Temporary partitions.
 - 11. Fire protection.
- E. Related Sections include the following:
 - 1. Division 1 Section - Submittal Procedures for procedures for submitting copies of implementation and termination schedule and utility reports.
 - 2. Division 1 Section - Execution Requirements for progress cleaning requirements.
 - 3. Divisions 2 through 48 Sections for temporary heat, ventilation, and humidity requirements for products in those Sections.

1.03 DEFINITIONS

- A. Permanent Enclosure: As determined by Architect, permanent or temporary roofing is complete, insulated, and weathertight; exterior walls are insulated and weathertight; and all openings are closed with permanent construction or substantial temporary closures.

1.04 USE CHARGES

- A. General: Cost or use charges for temporary facilities are not chargeable to Owner or Architect and shall be included in the Contract Sum. Allow other entities to use temporary services and facilities without cost, including, but not limited to, the following:
 - 1. Owner's maintenance personnel.
 - 2. Occupants of Project.
 - 3. Architect.
 - 4. Testing agencies.
 - 5. Personnel of authorities having jurisdiction.
- B. Sewer Service: Pay sewer service use charges for sewer usage, by all parties engaged in construction, at Project site.
- C. Water Service: Pay water-service use charges for water used by all entities for construction operations.
- D. Electric Power Service: Pay electric-power-service use charges for electricity used by all entities for construction operations.

1.05 SUBMITTALS

- A. Temporary Utility Reports: Submit reports of tests, inspections, meter readings, and similar procedures performed on temporary utilities.

1.06 QUALITY ASSURANCE

- A. Standards: Comply with ANSI A10.6, NECA's "Temporary Electrical Facilities," and NFPA 241.
 - 1. Trade Jurisdictions: Assigned responsibilities for installation and operation of temporary utilities are not intended to interfere with trade regulations and union jurisdictions.
 - 2. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.
- C. Accessible Temporary Egress: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

1.07 PROJECT CONDITIONS

- A. Temporary Utilities: At earliest feasible time, when acceptable to Owner, change over from use of temporary service to use of permanent service.
 - 1. Temporary Use of Permanent Facilities: Installer of each permanent service shall assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.
- B. Conditions of Use: The following conditions apply to use of temporary services and facilities by all parties engaged in the Work:
 - 1. Keep temporary services and facilities clean and neat.
 - 2. Relocate temporary services and facilities as required by progress of the Work.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. General: Provide new materials. Undamaged, previously used materials in serviceable condition may be used if approved by Architect. Provide materials suitable for use intended.
- B. Chain-Link Fencing: Minimum 2-inch, 0.148-inch- thick, galvanized steel, chain-link fabric fencing; minimum 6 feet high with galvanized steel pipe posts; minimum 2-3/8-inch- OD line posts and 2-7/8-inch- OD corner and pull posts, with 1-5/8-inch- OD top rails.
- C. Wood Enclosure Fence: Plywood, [6 feet] [8 feet] high, framed with four 2-by-4-inch rails, with preservative-treated wood posts spaced not more than 8 feet apart.
- D. Portable Chain-Link Fencing: Minimum 2-inch 9-gage, galvanized steel, chain-link fabric fencing; minimum 6 feet high with galvanized steel pipe posts; minimum 2-3/8-inch- OD line posts and 2-7/8-inch- OD corner and pull posts, with 1-5/8-inch- OD top and bottom rails. Provide concrete or galvanized steel bases for supporting posts.
- E. Lumber and Plywood: Comply with requirements in Division 6 Section - Carpentry.
- F. Gypsum Board: Minimum 1/2 inch thick by 48 inches wide by maximum available lengths; regular-type panels with tapered edges. Comply with ASTM C 36.
- G. Insulation: Unfaced mineral-fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame-spread and smoke-developed indices of 25 and 50, respectively.
- H. Paint: Comply with requirements in Division 9 Section - Painting.
- I. Tarpaulins: Fire-resistive labeled with flame-spread rating of 15 or less.
- J. Polyethylene Sheet: Reinforced, fire-resistive sheet, 10-mil minimum thickness, with flame-spread rating of 15 or less per ASTM E 84 and passing NFPA 701 Test Method 2.
- K. Dust-Control Adhesive-Surface Walk-off Mats: Provide mats minimum 36 by 60 inches
- L. Water: Potable.

2.02 EQUIPMENT

- A. General: Provide equipment suitable for use intended.
- B. Field Offices: Prefabricated Mobile units with lockable entrances, operable windows, and serviceable finishes; heated and air conditioned; on foundations adequate for normal loading.
- C. Common-Use Field Office: Of sufficient size to accommodate needs of Owner, Architect and construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections. Keep office clean and orderly. Furnish and equip offices as follows:
 - 1. Furniture required for Project-site documents including file cabinets, plan tables, plan racks, and bookcases.
 - 2. Conference room of sufficient size to accommodate meetings of 10 individuals. Provide electrical power service and 120-V ac duplex receptacles, with no fewer than one receptacle on each wall. Furnish room with conference table, chairs, and tack & marker boards.
 - 3. Drinking water and private toilet.
 - 4. Coffee machine and supplies.
 - 5. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F.
 - 6. Lighting fixtures capable of maintaining average illumination of 20 fc.

- D. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations. Store combustible materials apart from building.
- E. Fire Extinguishers: Hand carried, portable, UL rated. Provide class and extinguishing agent as indicated or a combination of extinguishers of NFPA-recommended classes for exposures.
 - 1. Comply with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure.
- F. Self-Contained Toilet Units: Single-occupant units of chemical, aerated recirculation, or combustion type; vented; fully enclosed with a glass-fiber-reinforced polyester shell or similar nonabsorbent material.
- G. Drinking-Water Fixtures: Containerized, tap-dispenser, bottled-water drinking-water units, including paper cup supply.
 - 1. Where power is accessible, provide electric water coolers to maintain dispensed water temperature at 45 to 55 deg F.
- H. Heating Equipment: Unless Owner authorizes use of permanent heating system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
 - 1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
 - 2. Heating Units: Listed and labeled, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use for type of fuel being consumed.
 - 3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of [8] at each return-air grille in system and remove at end of construction and clean HVAC system as required in Division 01 Section - Closeout Procedures.
- I. Electrical Outlets: Properly configured, NEMA-polarized outlets to prevent insertion of 110- to 120-V plugs into higher-voltage outlets; equipped with ground-fault circuit interrupters, reset button, and pilot light.
- J. Power Distribution System Circuits: Where permitted and overhead and exposed for surveillance, wiring circuits, not exceeding 125-V ac, 20-A rating, and lighting circuits may be nonmetallic sheathed cable.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required.
- B. Provide each facility ready for use when needed to avoid delay. Maintain and modify as required. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.02 TEMPORARY UTILITY INSTALLATION

- A. General: Engage appropriate local utility company to install temporary service or connect to existing service. Where utility company provides only part of the service, provide the remainder with matching, compatible materials and equipment. Comply with utility company recommendations.
 - 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.

2. Provide adequate capacity at each stage of construction. Before temporary utility is available, provide trucked-in services.
 3. Obtain easements to bring temporary utilities to Project site where Owner's easements cannot be used for that purpose.
- B. Water Service: Provide temporary water service as required for construction.
1. Provide rubber hoses as necessary to serve Project site.
 2. Install water service and distribution piping in sizes and pressures adequate for construction.
 3. As soon as water is required at each level, extend service to form a temporary water- and fire-protection standpipe. Provide distribution piping. Space outlets so water can be reached with a 100-foot (30-m) hose. Provide one hose at each outlet.
 4. Where installations below an outlet might be damaged by spillage or leakage, provide a drip pan of suitable size to minimize water damage. Drain accumulated water promptly from pans.
 5. Provide pumps to supply a minimum of 30-psi static pressure at highest point. Equip pumps with surge and storage tanks and automatic controls to supply water uniformly at reasonable pressures.
- C. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking-water fixtures. Comply with regulations and health codes for type, number, location, operation, and maintenance of fixtures and facilities. Existing sanitary facilities and new sanitary facilities shall not be used by contractor personnel.
1. Disposable Supplies: Provide toilet tissue, paper towels, paper cups, and similar disposable materials for each facility. Maintain adequate supply. Provide covered waste containers for disposal of used material.
 2. Toilets: Install self-contained toilet units. Shield toilets to ensure privacy. Provide separate facilities for male and female personnel.
 3. Toilets: Install toilet facilities connected to local water and sewer lines. Provide lavatories, mirrors, urinals, and water closets. Provide only potable-water connections. Provide individual compartments for water closets. Provide suitable enclosure with nonabsorbent sanitary finish materials and adequate heat, ventilation, and lighting.
 4. Wash Facilities: Install wash facilities supplied with potable water at convenient locations for personnel who handle materials that require wash up. Dispose of drainage properly. Supply cleaning compounds appropriate for each type of material handled.
 - a. Provide safety showers, eyewash fountains, and similar facilities for convenience, safety, and sanitation of personnel.
 5. Drinking-Water Facilities: Provide bottled-water, drinking-water units.
 - a. Where power is accessible, provide electric water coolers to maintain dispensed water temperature at 45 to 55 deg F.
- D. Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment from that specified that will not have a harmful effect on completed installations or elements being installed.
1. Maintain a minimum temperature of 50 deg F in permanently enclosed portions of building for normal construction activities, and 65 deg F for finishing activities and areas where finished Work has been installed.
- E. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment from that specified that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize

- energy consumption. Provide dehumidification systems when required to reduce substrate moisture levels to level required to allow installation or application of finishes.
- F. Electric Distribution: Provide temporary electric power service as required for construction, including receptacle outlets adequate for connection of power tools and equipment.
1. Provide waterproof connectors to connect separate lengths of electrical power cords if single lengths will not reach areas where construction activities are in progress. Do not exceed safe length-voltage ratio.
 2. Provide warning signs at power outlets other than 110 to 120 V.
 3. Provide metal conduit, tubing, or metallic cable for wiring exposed to possible damage. Provide rigid steel conduits for wiring exposed on grades, floors, decks, or other traffic areas.
 4. Provide metal conduit enclosures or boxes for wiring devices.
 5. Provide 4-gang outlets, spaced so 100-foot extension cord can reach each area for power hand tools and task lighting. Provide a separate 125-V ac, 20-A circuit for each outlet.
- G. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations and traffic conditions.
1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
 2. Provide one 100-W incandescent lamp per 500 sq. ft., uniformly distributed, for general lighting, or equivalent illumination.
 3. Provide one 100-W incandescent lamp every 50 feet in traffic areas.
 4. Provide one 100-W incandescent lamp per story in stairways and ladder runs, located to illuminate each landing and flight.
 5. Install exterior-yard site lighting that will provide adequate illumination for construction operations, traffic conditions, and signage visibility when the Work is being performed.
 6. Install lighting for Project identification sign.
- H. Telephone Service: Provide temporary telephone service throughout construction period for common-use facilities used by all personnel engaged in construction activities. Install separate telephone line for each field office and first-aid station.
1. Provide additional telephone lines for the following:
 - a. In field office with more than two occupants, install a telephone for each additional occupant or pair of occupants.
 - b. Provide a dedicated telephone line for each facsimile machine and computer with Internet connection in the field office.
 2. At each telephone, post a list of important telephone numbers.
 - a. Police and fire departments.
 - b. Ambulance service.
 - c. Contractor's home office.
 - d. Architect's office.
 - e. Engineers' offices.
 - f. Owner's office.
 - g. Principal subcontractors' field and home offices.
 3. Provide an answering machine, voice-mail service, or messaging service on superintendent's telephone.
 4. Furnish superintendent with a portable cellular telephone for use in making and receiving telephone calls when away from field office.
- I. Electronic Communication Service: Provide a desktop computer in the primary field office adequate for use by Contractor, Architect and Owner to access Project electronic documents and maintain electronic communications.

- J. Digital Camera: Provide a digital camera for superintendant to transmit photographs to Architect & Owner.

3.03 SUPPORT FACILITIES INSTALLATION

- A. General: Comply with the following:
1. Locate field offices, storage sheds, sanitary facilities, and other temporary construction and support facilities for easy access.
 2. Provide incombustible construction for offices, shops, and sheds located within construction area or within 30 feet of building lines. Comply with NFPA 241.
 3. Maintain support facilities until near Substantial Completion. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.
- B. Traffic Controls: Provide temporary traffic controls at junction of temporary roads with public roads. Include warning signs for public traffic and "STOP" signs for entrance onto public roads. Comply with requirements of authorities having jurisdiction.
- C. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations. Locate temporary roads and paved areas [as indicated] [within construction limits indicated] on Drawings.
1. Provide dust-control treatment that is nonpolluting and non-tracking. Reapply treatment as required to minimize dust.
- D. Temporary Use of Permanent Roads and Paved Areas: Locate temporary roads and paved areas in same location as permanent roads and paved areas. Construct and maintain temporary roads and paved areas adequate for construction operations. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.
1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.
 2. Prepare subgrade and install sub-base and base for temporary roads and paved areas according to Division 31 Section - Earth Moving.
 3. Recondition base after temporary use, including removing contaminated material, re-grading, proof-rolling, compacting, and testing.
- E. Dewatering Facilities and Drains: Comply with requirements in applicable sections for temporary drainage and dewatering facilities and operations not directly associated with construction activities included in individual Sections. Where feasible, use same facilities. Maintain Project site, excavations, and construction free of water.
1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining property nor endanger permanent Work or temporary facilities.
 2. Before connection and operation of permanent drainage piping system, provide temporary drainage where roofing or similar waterproof deck construction is completed.
 3. Remove snow and ice as required to minimize accumulations.
- F. Project Identification and Temporary Signs: Prepare Project identification and other signs in sizes indicated. Install signs where indicated to inform public and persons seeking entrance to Project. Do not permit installation of unauthorized signs.
1. Engage an experienced sign painter to apply graphics for Project identification signs. Comply with details indicated.
 2. Prepare temporary signs to provide directional information to construction personnel and visitors.
 3. Construct signs of exterior-type Grade B-B high-density concrete-form overlay plywood in sizes and thicknesses indicated. Support on posts or framing of preservative-treated wood or steel.

4. Paint sign panel and applied graphics with exterior-grade alkyd gloss enamel over exterior primer.
 5. Maintain and touchup signs so they are legible at all times.
- G. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Containerize and clearly label hazardous, dangerous, or unsanitary waste materials separately from other waste. Comply with Division 1 Section - Execution Requirements for progress cleaning requirements. Comply with requirements specified in Division 1 Section - Construction Waste Management and Disposal.
1. If required by authorities having jurisdiction, provide separate containers, clearly labeled, for each type of waste material to be deposited.
 2. Develop a waste management plan for Work performed on Project. Indicate types of waste materials Project will produce and estimate quantities of each type. Provide detailed information for on-site waste storage and separation of recyclable materials. Provide information on destination of each type of waste material and means to be used to dispose of all waste materials.
- H. Janitorial Services: Provide janitorial services on a daily basis for temporary offices, first-aid stations, toilets, wash facilities, lunchrooms, and similar areas.
- I. Common-Use Field Office: Provide an insulated, weathertight, air-conditioned field office for use as a common facility by all personnel engaged in construction activities; of sufficient size to accommodate required office personnel and meetings of 10 persons at Project site. Keep office clean and orderly.
1. Furnish and equip offices as follows:
 - a. Desk and four chairs, four-drawer file cabinet, a plan table, a plan rack, and bookcase.
 - b. Water cooler and private toilet complete with water closet, lavatory, and medicine cabinet with mirror.
 - c. Provide a room of not less than 240 sq. ft. for Project meetings. Furnish room with conference table, 12 folding chairs, and 4-foot- square tack board.
 2. Provide an electric heater with thermostat capable of maintaining a uniform indoor temperature of 68 deg F. Provide an air-conditioning unit capable of maintaining an indoor temperature of 72 deg F.
 3. Provide fluorescent light fixtures capable of maintaining average illumination of 20 fc at desk height. Provide 110- to 120-V duplex outlets spaced at not more than 12-foot intervals, 1 per wall in each room.
- J. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment involved, including temporary utility services. Sheds may be open shelters or fully enclosed spaces within building or elsewhere on-site.
1. Construct framing, sheathing, and siding using fire-retardant-treated lumber and plywood.
 2. Paint exposed lumber and plywood with exterior-grade acrylic-latex emulsion over exterior primer.
- K. Lifts and Hoists: Provide facilities for hoisting materials and personnel. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.
1. Existing Elevator Usage: Use of Owner's existing elevators will be not be permitted.
- L. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate. Cover finished, permanent stairs with protective covering of plywood or similar material so finishes will be undamaged at time of acceptance.

3.04 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects. Avoid using tools and equipment that produce harmful noise. Restrict use of noisemaking tools and equipment to hours that will minimize complaints from persons or firms near Project site.
- B. Temporary Erosion and Sedimentation Control: Comply with requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent and requirements specified in Division 31 Section - Site Clearing.
- C. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to erosion and sedimentation control drawings or requirements of authorities having jurisdiction, whichever is more stringent.
 - 1. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree- or plant- protection zones.
 - 2. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
 - 3. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from Project site during the course of Project.
 - 4. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.
- D. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
- E. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from construction damage. Protect tree root systems from damage, flooding, and erosion.
- F. Pest Control: Before deep foundation work has been completed, retain a local exterminator or pest-control company to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests. Engage this pest-control service to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Obtain extended warranty for Owner. Perform control operations lawfully, using environmentally safe materials.
- G. Site Enclosure Fence: Before construction operations begin, install chain-link enclosure fence with lockable entrance gates. Locate where indicated, or enclose entire Project site or portion determined sufficient to accommodate construction operations. Install in a manner that will prevent people, dogs, and other animals from easily entering site except by entrance gates.
 - 1. Set fence posts in concrete bases.
 - 2. Provide gates in sizes and at locations necessary to accommodate delivery vehicles and other construction operations.
 - 3. Option in subparagraph below is only for projects connected to existing construction.
 - 4. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Provide Owner with one set of keys.
- H. Security Enclosure and Lockup: Install substantial temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each day.

- I. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.
- J. Barricades, Warning Signs, and Lights: Comply with standards and code requirements for erecting structurally adequate barricades. Paint with appropriate colors, graphics, and warning signs to inform personnel and public of possible hazard. Where appropriate and needed, provide lighting, including flashing red or amber lights.
 - 1. For safety barriers, sidewalk bridges, and similar uses, provide minimum 5/8-inch thick exterior plywood.
- K. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
 - 1. Where heating or cooling is needed and permanent enclosure is not complete, provide insulated temporary enclosures. Coordinate enclosure with ventilating and material drying or curing requirements to avoid dangerous conditions and effects.
 - 2. Vertical Openings: Close openings of 25 sq. ft. or less with plywood or similar materials.
 - 3. Horizontal Openings: Close openings in floor or roof decks and horizontal surfaces with load-bearing, wood-framed construction.
 - 4. Install tarpaulins securely using fire-retardant-treated wood framing and other materials.
 - 5. Where temporary wood or plywood enclosure exceeds 100 sq. ft. in area, use fire-retardant-treated material for framing and main sheathing.
- L. Temporary Partitions: Erect and maintain dustproof partitions and temporary enclosures to limit dust and dirt migration and to separate areas from fumes and noise. Prevent from entering occupied areas.
 - 1. Construct dustproof partitions of not less than nominal 4-inch studs, 5/8-inch gypsum wallboard with joints taped on occupied side, and 1/2-inch fire-retardant plywood on construction side.
 - 2. Construct dustproof, floor-to-ceiling partitions of not less than nominal 4-inch studs, 2 layers of 3-mil polyethylene sheets, inside and outside temporary enclosure. Cover floor with 2 layers of 3-mil polyethylene sheets, extending sheets 18 inches up the side walls. Overlap and tape full length of joints. Cover floor with 3/4-inch fire-retardant plywood.
 - a. Construct a vestibule and airlock at each entrance to temporary enclosure with not less than 48 inches between doors. Maintain water-dampened foot mats in vestibule.
 - 3. Insulate partitions to provide noise protection to occupied areas.
 - 4. Prior to commencing work, isolate the HVAC system in area where work is to be performed according to coordination drawings.
 - a. Disconnect supply and return ductwork in work area from HVAC systems servicing occupied areas.
 - b. Maintain negative air pressure within work area using HEPA-equipped air-filtration units, starting with commencement of temporary partition construction, and continuing until removal of temporary partitions is complete.
 - 5. Maintain dust partitions during the Work. Use vacuum collection attachments on dust-producing equipment. Isolate limited work within occupied areas using portable dust-containment devices.
 - 6. Perform daily construction cleanup and final cleanup using approved, HEPA-filter-equipped vacuum equipment.
 - 7. Seal joints and perimeter. Equip partitions with dustproof doors and security locks.
 - 8. Protect air-handling equipment.
 - 9. Weatherstrip openings.
- M. Temporary Fire Protection: Until fire-protection needs are supplied by permanent facilities, install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241.

1. Provide fire extinguishers, installed on walls on mounting brackets, visible and accessible from space being served, with sign mounted above.
 - a. Field Offices: Class A stored-pressure water-type extinguishers.
 - b. Other Locations: Class ABC dry-chemical extinguishers or a combination of extinguishers of NFPA-recommended classes for exposures.
 - c. Locate fire extinguishers where convenient and effective for their intended purpose; provide not less than one extinguisher on each floor at or near each usable stairwell.
2. Store combustible materials in containers in fire-safe locations.
3. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire-protection facilities, stairways, and other access routes for firefighting. Provide temporary key boxes and Knox padlocks for gates and secured areas throughout construction as required by authorities having jurisdiction.
4. Prohibit smoking in construction areas.
5. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition.
6. Permanent Fire Protection: At earliest feasible date in each area of Project, complete installation of permanent fire-protection facility, including connected services, and place into operation and use. Instruct key personnel on use of facilities.
7. Develop and supervise an overall fire-prevention and first-aid fire-protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
8. Provide hoses for fire protection of sufficient length to reach construction areas. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.
9. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.05 MOISTURE AND MOLD CONTROL

- A. Contractor's Moisture-Protection Plan: Avoid trapping water in finished work. Document visible signs of mold that may appear during construction.
- B. Exposed Construction Phase: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:
 1. Protect porous materials from water damage.
 2. Protect stored and installed material from flowing or standing water.
 3. Keep porous and organic materials from coming into prolonged contact with concrete.
 4. Remove standing water from decks.
 5. Keep deck openings covered or dammed.
- C. Partially Enclosed Construction Phase: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:
 1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
 2. Keep interior spaces reasonably clean and protected from water damage.
 3. Periodically collect and remove waste containing cellulose or other organic matter.
 4. Discard or replace water-damaged material.
 5. Do not install material that is wet.
 6. Discard, replace, or clean stored or installed material that begins to grow mold.
 7. Perform work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.

- D. Controlled Construction Phase of Construction: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:
1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
 2. Use permanent HVAC system to control humidity.
 3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits:
 - a. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during the course of construction and remain wet for 48 hours are considered defective.
 - b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record readings beginning at time of exposure and continuing daily for 48 hours. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect.
 - c. Remove materials that cannot be completely restored to their manufactured moisture level within 48 hours.

3.06 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal. Protect from damage caused by freezing temperatures and similar elements.
1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
 2. Prevent water-filled piping from freezing. Maintain markers for underground lines. Protect from damage during excavation operations.
- C. Operate Project-identification-sign lighting daily from dusk until 12:00 midnight.
- D. Temporary Facility Changeover: Except for using permanent fire protection as soon as available, do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- E. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
1. Materials and facilities that constitute temporary facilities are the property of Contractor. Owner reserves right to take possession of Project identification signs.
 2. Remove temporary paving not intended for or acceptable for integration into permanent paving. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
 3. At Substantial Completion, clean and renovate permanent facilities used during construction period. Comply with final cleaning requirements in Division 1 Section - Closeout Procedures.

END OF SECTION 01 50 00

SECTION 01 60 00 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following administrative and procedural requirements: selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; product substitutions; and comparable products.
- B. Related Sections include the following:
 - 1. Division 1 Section - Allowances for products selected under an allowance.
 - 2. Division 1 Section - Alternates for products selected as an alternate.
 - 3. Division 1 Section - Substitutions for products selected as a substitute.
 - 4. Division 1 Section - References for applicable industry standards for products specified.
 - 5. Division 1 Section - Closeout Procedures for submitting warranties for contract closeout.
 - 6. Divisions 2 - 48 Sections for specific requirements for warranties on products and installations specified to be warranted.

1.03 DEFINITIONS

- A. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation, shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.
 - 2. New Products: Items that have not previously been incorporated into another project or facility, except that products consisting of recycled-content materials are allowed, unless explicitly stated otherwise. Products salvaged or recycled from other projects are not considered new products.
 - 3. Comparable Product: Product that is demonstrated and approved through submittal process, or where indicated as a product substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
- C. Basis-of-Design Product Specification: Where a specific manufacturer's product is named and accompanied by the words "basis of design," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of other named manufacturers.
- D. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
- E. Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.

1.04 SUBMITTALS

- A. Product List: Submit a list, in tabular form, showing specified products. Include generic names of products required. Include manufacturer's name and proprietary product names for each product.
 - 1. Coordinate product list with Contractor's Construction Schedule and the Submittals Schedule.
 - 2. Form: Tabulate information for each product under the following column headings:
 - a. Specification Section number and title.
 - b. Generic name used in the Contract Documents.
 - c. Proprietary name, model number, and similar designations.
 - d. Manufacturer's name and address.
 - e. Supplier's name and address.
 - f. Installer's name and address.
 - g. Projected delivery date or time span of delivery period.
 - h. Identification of items that require early submittal approval for scheduled delivery date.
 - 3. Initial Submittal: Within 30 days after date of commencement of the Work, submit 3 copies of initial product list. Include a written explanation for omissions of data and for variations from Contract requirements.
 - a. At Contractor's option, initial submittal may be limited to product selections and designations that must be established early in Contract period.
 - 4. Completed List: Within 30 days after date of commencement of the Work, submit 3 copies of completed product list. Include a written explanation for omissions of data and for variations from Contract requirements.
 - 5. Architect's Action: Architect will respond in writing to Contractor within 15 working days of receipt of completed product list if there are objections to the list. Architect's response will include a list of unacceptable product selections and a brief explanation of reasons for this action. Architect's response, or lack of response, does not constitute a waiver of requirement that products comply with the Contract Documents.
- B. Basis-of-Design Product Specification Submittal: Comply with requirements in Division 1 Section - Submittal Procedures. Show compliance with requirements.

1.05 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, product selected shall be compatible with products previously selected, even if previously selected products were also options.
 - 1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
 - 2. If a dispute arises between contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.

1.06 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions.
 - 1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
 - 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.

3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.
5. Store products to allow for inspection and measurement of quantity or counting of units.
6. Store materials in a manner that will not endanger Project structure.
7. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
8. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
9. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
10. Protect stored products from damage and liquids from freezing.
11. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.07 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
 1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
 2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.
 1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
 2. Refer to Divisions 2 through 48 Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Division 1 Section - Closeout Procedures.

PART 2 - PRODUCTS

2.01 PRODUCT OPTIONS

- A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged, and unless otherwise indicated, that are new at time of installation.
 1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
 3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
 4. Where products are accompanied by the term "as selected," Architect will make selection.
 5. Where products are accompanied by the term "match sample," sample to be matched is Architect's.

6. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.
 7. Or Equal: Where products are specified by name and accompanied by the term "or equal", "or approved equal", "or approved," or "acceptable substitution", comply with provisions in "Comparable Products" Article to obtain approval for use of an unnamed product.
- B. Product Selection Procedures: Procedures for product selection include the following:
1. Product: Where Specification paragraphs or subparagraphs titled "Product" name a single product and manufacturer, provide the product named.
 - a. Substitutions may be considered, unless otherwise indicated.
 2. Manufacturer/Source: Where Specification paragraphs or subparagraphs titled "Manufacturer" or "Source" name single manufacturers or sources, provide a product by the manufacturer or from the source named that complies with requirements.
 - a. Substitutions may be considered, unless otherwise indicated.
 3. Products: Where Specification paragraphs or subparagraphs titled "Products" introduce a list of names of both products and manufacturers, provide one of the products listed that complies with requirements.
 - a. Substitutions may be considered, unless otherwise indicated.
 4. Manufacturers: Where Specification paragraphs or subparagraphs titled "Manufacturers" introduce a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.
 - a. Substitutions may be considered, unless otherwise indicated.
 5. Available Products: Where Specification paragraphs or subparagraphs titled "Available Products" introduce a list of names of both products and manufacturers, provide one of the products listed or another product that complies with requirements. Comply with provisions in "Comparable Products" Article to obtain approval for use of an unnamed product.
 6. Available Manufacturers: Where Specification paragraphs or subparagraphs titled "Available Manufacturers" introduce a list of manufacturers' names, provide a product by one of the manufacturers listed or another manufacturer that complies with requirements. Comply with provisions in "Comparable Products" Article to obtain approval for use of an unnamed product.
 7. Product Options: Where Specification paragraphs titled "Product Options" indicate that size, profiles, and dimensional requirements on Drawings are based on a specific product or system, provide either the specific product or system indicated or a comparable product or system by another manufacturer. Comply with provisions in "Product Substitutions" Article.
 8. Basis-of-Design Products: Where Specification paragraphs or subparagraphs titled "Basis-of-Design Products" are included and also introduce or refer to a list of manufacturers' names, provide either the specified product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with provisions in "Comparable Products" Article to obtain approval for use of an unnamed product.
 - a. Substitutions may be considered, unless otherwise indicated.
 9. Visual Matching Specification: Where Specifications require matching an established Sample, select a product (and manufacturer) that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches satisfactorily.
 - a. If no product available within specified category matches satisfactorily and complies with other specified requirements, comply with provisions of the Contract Documents on "substitutions" for selection of a matching product.

10. Visual Selection Specification: Where Specifications include the phrase "as selected from manufacturer's colors, patterns, textures" or a similar phrase, select a product (and manufacturer) that complies with other specified requirements.
 - a. Standard Range: Where Specifications include the phrase "standard range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, or texture from manufacturer's product line that does not include premium items.
 - b. Full Range: Where Specifications include the phrase "full range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, or texture from manufacturer's product line that includes both standard and premium items.
11. Allowances: Refer to individual Specification Sections and "Allowance" provisions in Division 1 for allowances that control product selection and for procedures required for processing such selections.

2.02 COMPARABLE PRODUCTS

- A. Conditions for Consideration: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with these requirements:
 1. Evidence that the proposed product does not require extensive revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
 2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
 3. Evidence that proposed product provides specified warranty.
 4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
 5. Samples, if requested.

PART 3 - EXECUTION

Not Used.

END OF SECTION 01 60 00

SECTION 01 73 00 - EXECUTION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:
 - 1. Construction layout.
 - 2. Field engineering and surveying.
 - 3. Installation of the Work.
 - 4. Cutting and patching.
 - 5. Coordination of Owner-installed products.
 - 6. Progress cleaning.
 - 7. Starting and adjusting.
 - 8. Protection of installed construction.
 - 9. Correction of the Work.
- B. Related Requirements:
 - 1. Division 01 Section - Summary for limits on use of Project site.
 - 2. Division 01 Section - Submittal Procedures for submitting surveys.
 - 3. Division 01 Section - Cutting and Patching for cutting and patching necessary for installation or performance of other components of the work.
 - 4. Division 01 Section - Closeout Procedures for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.
 - 5. Division 02 Section - Selective Structure Demolition for demolition and removal of selected portions of the building.
 - 6. Division 07 Section - Penetration Firestopping for patching penetrations in fire-rated construction.

1.03 DEFINITIONS

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of other work.
- B. Patching: Fitting and repair work required to restore construction to original conditions after installation of other work.

1.04 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For land surveyor.
- B. Certificates: Submit certificate signed by land surveyor certifying that location and elevation of improvements comply with requirements.
- C. Cutting and Patching Plan: Submit plan describing procedures at least 10 days prior to the time cutting and patching will be performed. Include the following information:
 - 1. Extent: Describe reason for and extent of each occurrence of cutting and patching.
 - 2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building appearance and other significant visual elements.

3. Products: List products to be used for patching and firms or entities that will perform patching work.
 4. Dates: Indicate when cutting and patching will be performed.
- D. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.
- E. Certified Surveys: Submit two copies signed by land surveyor.

1.05 QUALITY ASSURANCE

- A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.
- B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
1. Structural Elements: When cutting and patching structural elements, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection
 2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operational elements include the following:
 - a. Primary operational systems and equipment.
 - b. Fire separation assemblies.
 - c. Air or smoke barriers.
 - d. Fire-suppression systems.
 - e. Mechanical systems piping and ducts.
 - f. Control systems.
 - g. Communication systems.
 - h. Fire detection and alarm systems.
 - i. Conveying systems.
 - j. Electrical wiring systems.
 3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Other construction elements include but are not limited to the following:
 - a. Water, moisture, or vapor barriers.
 - b. Membranes and flashings.
 - c. Sprayed fire-resistive material.
 - d. Equipment supports.
 - e. Piping, ductwork, vessels, and equipment.
 - f. Noise- and vibration-control elements and systems.
 4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
- C. Cutting and Patching Conference: Before proceeding, meet at Project site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of

potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

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

PART 2 - PRODUCTS

2.01 MATERIALS

- A. General: Comply with requirements specified in other Sections.
- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
 - 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, and other construction affecting the Work.
 - 1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services, and other utilities.
 - 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
 - 3. In the event of any inconsistency or conflict, between existing conditions and the bidding documents, immediate notice of such inconsistency or conflict shall be given to the Architect. Do not undertake any phase of the work affected by such inconsistency or conflict, pending the issuance of instructions by the Architect.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
 - 1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 - 2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 - 3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
 - 1. Description of the Work.
 - 2. List of detrimental conditions, including substrates.
 - 3. List of unacceptable installation tolerances.
 - 4. Recommended corrections.
- D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.02 PREPARATION

- A. Existing Utility Information: Furnish information to local utility that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Owner not less than five days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Owner's written permission.
- C. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- D. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- E. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect according to requirements in Division 01 Section - Project Management and Coordination.

3.03 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.
- B. General: Engage a land surveyor to lay out the Work using accepted surveying practices.
 - 1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
 - 2. Establish limits on use of Project site.
 - 3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
 - 4. Inform installers of lines and levels to which they must comply.
 - 5. Check the location, level and plumb, of every major element as the Work progresses.
 - 6. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
 - 7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.
- D. Elevations of existing grades, floors, tops of walls, parapets, beams and locations of existing columns, walls and the like are based on survey documents or on drawings of the existing building furnished by the Owner. The Architect assumes no responsibility for the accuracy of the information on existing drawings. It is the intent of the Contract Drawings to integrate new work with existing improvements and for the Contractor to verify actual conditions.
- E. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical

and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

- F. Subcontractors shall verify with the General Contractor the exact field location of all rough-in dimensions, taking into account location of walls, partitions and equipment. Special attention should be paid to clearances as required for compliance with American's with Disabilities Act Accessibility Guidelines (ADAAG) in the state having jurisdiction, including any applicable revisions. Any cost in relocation of items due to that subcontractor's error, will be borne by him at no additional cost to the Owner.
- G. Where equipment involving more than one subcontractor is installed at a common location and no specific location has been determined, it is the Contractor's responsibility to check with the Architect for the actual rough-in dimensions for such equipment. If for some reason the rough-in has not been checked and a subcontractor has installed his equipment, remaining subcontractors shall align their equipment as closely as possible to the installed equipment. Alignment shall mean centered vertically, equally space and centered horizontally. This alignment applies to bells, alarms, thermostats, switches, handles, access panels, etc. Any items not installed in alignment shall be relocated by the Contractor at his own expense with damaged surfaces properly repaired.
- H. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.04 FIELD ENGINEERING

- A. Identification: Owner will identify existing benchmarks, control points, and property corners.
- B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
 - 1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.
 - 2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.
- C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
 - 1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
 - 2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
 - 3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.
- D. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.

3.05 INSTALLATION

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

1. Make vertical work plumb and make horizontal work level.
 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
 4. Maintain minimum headroom clearance of 96 inch in occupied spaces and 90 inch in unoccupied spaces.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.
- F. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- G. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.
1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
 2. Allow for building movement, including thermal expansion and contraction.
 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- I. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- J. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.06 CUTTING AND PATCHING

- A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.
- C. Temporary Support: Provide temporary support of work to be cut.

- D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- E. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
 - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 - 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 - 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 - 4. Excavating and Backfilling: Comply with requirements in applicable Division 31 Sections where required by cutting and patching operations.
 - 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 - 6. Proceed with patching after construction operations requiring cutting are complete.
- F. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.
 - 1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
 - 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.
 - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
 - b. Restore damaged pipe covering to its original condition.
 - 3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
 - 4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
 - 5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.
- G. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.07 OWNER-INSTALLED PRODUCTS

- A. Site Access: Provide access to Project site for Owner's construction personnel.

- B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel.
 - 1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
 - 2. Preinstallation Conferences: Include Owner's construction personnel at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.

3.08 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
 - 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 - 2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
 - 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
 - a. Use containers intended for holding waste materials of type to be stored.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
 - 1. Remove liquid spills promptly.
 - 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Division 01 Section - Temporary Facilities and Controls.
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.09 STARTING AND ADJUSTING

- A. Coordinate startup and adjusting of equipment and operating components with requirements in Division 01 Section - General Commissioning Requirements.
- B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Manufacturer's Field Service: Comply with qualification requirements in Division 01 Section - Quality Requirements.

3.10 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Comply with manufacturer's written instructions for temperature and relative humidity.
- C. Repair or remove and replace defective construction. Restore damaged substrates and finishes. Comply with requirements in Division 1 Section - Cutting and Patching.
 - 1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.
- D. Restore permanent facilities used during construction to their specified condition.
- E. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.
- F. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.
- G. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 01 73 00



REQUEST FOR INTERPRETATION

Project: _____ R.F.I. Number: _____

From: _____
To: _____ Date: _____

A/E Project Number: _____
Re: _____ Contract For: _____

Specification Section: _____ Paragraph: _____ Drawing Reference: _____ Detail: _____

Request:

Signed by: _____ Date: _____

Response:

☐ Attachments

Response From: _____ To: _____ Date Rec'd: _____ Date Ret'd: _____

Signed by: _____ Date: _____

Copies: ☐ Owner ☐ Consultants ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ File

REQUEST FOR INFORMATION - LOG

DATE: xx/xx/20xx
PROJECT: name
BID PACKAGE xxxxx
PROJECT NO.: xxxxx.xx
CONTRACTOR: name

RFI Type Legend:
R = RFI
U = Unforeseen Condition
F = Found in Documents
C = Confirming / Duplicating / Rewording Previous RFI
E = Resulting from Construction Error / Accident
S = Should be a Submittal

RFI NO.	DATE RCV'D	SUBJECT	DATE RETURNED	SENT TO	ANSWER	TYPE
001						
002						
003						
004						
005						
006						
007						
008						
009						
010						
011						
012						
013						
014						
015						
016						
017						
018						
019						
020						

RFI NO.	DATE RCV'D	SUBJECT	DATE RETURNED	SENT TO	ANSWER	TYPE
021						
022						
023						
024						
025						
026						
027						

SECTION 01 77 00 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
 - 1. Substantial Completion procedures.
 - 2. Final completion procedures.
 - 3. Warranties.
 - 4. Final cleaning.
 - 5. Repair of the Work.
- B. Related Requirements:
 - 1. Division 01 Section - Execution for Requirements for progress cleaning of Project site.
 - 2. Division 01 - Substantial Completion Readiness Checklist.
 - 3. Division 01 Section - Photographic Documentation for submitting final completion construction photographic documentation.
 - 4. Division 01 Section - Execution Requirements for progress cleaning of Project site.
 - 5. Division 01 Section - Operation and Maintenance Data for operation and maintenance manual requirements.
 - 6. Division 01 Section - Project Record Documents for submitting record Drawings, record Specifications, and record Product Data.
 - 7. Division 01 Section - Demonstration and Training for requirements for instructing Owner's personnel.
 - 8. Divisions 02 through 33 Sections for specific closeout and special cleaning requirements for the Work in those Sections.

1.03 QUALITY CONTROL

- A. Closeout Conference: Schedule and conduct a closeout conference, to be held one to three months prior to the anticipated date of substantial completion. Required attendees include Contractor's on-site personnel and Project Manager, Architect, and designated Owner's representative(s). Discuss any items that could impede progress to scheduled date of substantial completion, closeout procedures, and the following:
 - 1. Any pending or anticipated time extension requests that may affect the projected date of Substantial Completion.
 - 2. Progress or scheduled progress of Contractor's preparation of project record documents.
 - 3. Current status of Contractor's As-Built documents, and plans to address any deficiencies.
 - 4. Required Owner training, and process for scheduling training with Owner's staff.
 - 5. Required submittals to Architect prior to requesting inspection for Substantial Completion, including the Substantial Completion Readiness Checklist.
 - 6. Requirements for testing and balancing and for submitting Test / Adjust / Balance reports.
 - 7. Commissioning.
 - 8. Maximum time allowed between Substantial and Final Completion, and Contractor's plan to ensure that all incomplete work is completed on schedule.
 - 9. Written action plans required to address deficiencies (if any).

- B. Contractor shall record Closeout Conference minutes, including all Contractor's action items, and distribute to attendees within one week. Contractor shall attach plans to address deficiencies for any items identified in the Closeout Conference that require a written action plan.

1.04 ACTION SUBMITTALS

- A. Product Data: For cleaning agents.
- B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- C. Substantial Completion Readiness Checklist form: Fully filled out, submitted prior to or concurrent with requesting a date for substantial completion. See attached form.
- D. Certified List of Incomplete Items: Final submittal at Final Completion.

1.05 CLOSEOUT SUBMITTALS

- A. Certificates of Release: From authorities having jurisdiction.
- B. Certificate of Insurance: For continuing coverage.
- C. Field Report: For pest control inspection.

1.06 MAINTENANCE MATERIAL SUBMITTALS

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

1.07 SUBSTANTIAL COMPLETION PROCEDURES

- A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.
- B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
 - 1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 - 2. Submit a fully filled out Substantial Completion Readiness Checklist (see attachment to this specification Section).
 - 3. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.
 - 4. Submit closeout submittals specified in individual Divisions 02 through 33 Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 - 5. Submit maintenance material submittals specified in individual Divisions 02 through 33 Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number where applicable.
 - a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Architect's signature for receipt of submittals.
 - 6. Submit test/adjust/balance records.

7. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
- C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
 1. Review the Substantial Completion Readiness Checklist form (attached). Address habitual punch list items to the extent possible and note remaining items in Contractor's List of Incomplete Items. Ensure that other items indicated on the Checklist can or will be complete by the required dates and note any deficiencies on the checklist form prior to submitting it to Architect.
 2. Advise Owner of pending insurance changeover requirements.
 3. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
 4. Complete startup and testing of systems and equipment.
 5. Perform preventive maintenance on equipment used prior to Substantial Completion.
 6. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Division 01 Section - Demonstration and Training.
 7. Advise Owner of changeover in heat and other utilities.
 8. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
 9. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 10. Complete final cleaning requirements, including touchup painting.
 11. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
 1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
 2. Results of completed inspection will form the basis of requirements for final completion.

1.08 FINAL COMPLETION PROCEDURES

- A. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:
 1. Submit a final Application for Payment according to Division 01 Section - Payment Procedures.
 2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
 3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
 4. Submit pest-control final inspection report.
- B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests.

On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

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

1.09 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
 1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.
 2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
 3. Include the following information at the top of each page:
 - a. Project name.
 - b. Date.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Page number.
 4. Submit list of incomplete items in one of the following formats:
 - a. MS Excel electronic file. Architect will return annotated file.
 - b. PDF electronic file. Architect will return annotated file.

1.10 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.
- C. Organize entire collection of approved warranty documents into an orderly sequence based on the table of contents of Project Manual, with tabs between CSI division sections; i.e.; group all Division-7 building components under one tab, group all Division-8 components under another tab, etc.. Utilize CSI specification sections 2 through 33 for each division tab. Provide three copies of each Final Warranty binder.
 1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
 2. Provide title page, Contractor's general One-Year Warranty (corrective period) with agreed upon date and signature of authorized representative, table of contents, and subcontractor list at the beginning of each binder.
 3. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
 4. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.

5. Warranty Electronic File: Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
- D. Provide additional copies of each warranty to include in operation and maintenance manuals. Such copies shall be identical to the warranties included in the warranty binders, but may be photocopies including for warranties that require wet signatures for the original actuated copies.

PART 2 - PRODUCTS

2.01 MATERIALS

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

PART 3 - EXECUTION

3.01 FINAL CLEANING

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
 - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
 - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
 - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - e. Remove snow and ice to provide safe access to building.
 - f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
 - g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - h. Sweep concrete floors broom clean in unoccupied spaces.
 - i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
 - j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
 - k. Remove labels that are not permanent.

- l. Wipe surfaces of mechanical and electrical equipment [**elevator equipment,**] and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - m. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - n. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 - o. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
 - 1) Clean HVAC system in compliance with NADCA Standard 1992-01. Provide written report on completion of cleaning.
 - p. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
 - q. Leave Project clean and ready for occupancy.
- C. Pest Control: Comply with pest control requirements in Division 01 Section - Temporary Facilities and Controls. Prepare written report.
- D. Construction Waste Disposal: Comply with waste disposal requirements in Division 01 Section - Temporary Facilities and Controls.

3.02 REPAIR OF THE WORK

- A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.
- B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.
- 1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
 - 2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that already show evidence of repair or restoration.
 - a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.
 - 3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
 - 4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

END OF SECTION 01 77 00



PUNCH LIST

Project: _____

To (Contractor): _____

From (A/E): _____
Site Visit Date: _____
A/E Project Number: _____
Contract For: _____

The following items require the attention of the Contractor for completion or correction. This list may not be all-inclusive, and the failure to include any items on this list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

Item Number	Room Number	Location (Area)	Description	Correction/Completion Date	Verification A/E Check

☐ Attachments

Signed by: _____ Date: _____

Copies: ☐ Owner ☐ Consultants ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ File

01 77 00A - SUBSTANTIAL COMPLETION READINESS CHECKLIST

When requesting Architect's Inspection for Substantial Completion, the Contractor shall submit the following checklist and shall provide not less than 7 working days advance notice to the Architect and Owner (unless otherwise mutually agreed). Fill out form completely, including comments indicating reasons for incomplete items and anticipated completion as applicable. Architect will provide an editable version of this form upon request. The Architect will not schedule an Inspection for Substantial Completion without first receiving this completed form from the Contractor. Deficiencies in one or more items does not necessarily indicate that the project is not ready for inspection. However, incomplete items that preclude Owner's beneficial occupancy, or that constitute a lack of readiness for inspection, either individually or in aggregate, are grounds for the Architect to deny scheduling of the inspection. All deficiencies shall be reflected in Contractor's punch list. The Architect's inspection for substantial completion shall not be scheduled on a day when fire alarm testing or other extremely noisy construction activities are scheduled.

Item	Y	N	N/A	Documents / Actions Required
1				Contractor's Punch List (and Habitual Punch List Items Checked) <i>Submit Contractor's Punch List, noting all remaining work items with date scheduled for completion or correction. Contractor shall update and submit / re-submit list as applicable minimum of 2 days and maximum of 5 days prior to the requested date for Architect's Inspection, noting items contractor has corrected and that are still pending. Additionally, Contractor shall field verify the following habitual check list items in preparing the Contractor's Punch List, and indicate that they have been verified by the checklist below:</i>
	Comments:			
				Confirm there are no outstanding items on the Contractor's Punch List that would adversely affect the Owner's beneficial occupancy.
	Comments:			
				Confirm that all outstanding items on Contractor's Punch List can be completed, and are scheduled for completion, within a maximum of 30 calendar days, or other duration as allowed by the Contract Documents or mutually agreed between Contractor, Architect, and Owner.
	Comments:			
				The area of the Facility included in the Contractor's Work has been, or will be by the requested date, completely cleaned and ready for Architect's Inspection.
	Comments:			
				Temporary Facilities have been removed, or will be removed, by requested date of Inspection (except for any items otherwise mutually agreed to remain after the date of Owner's beneficial occupancy).
	Comments:			
				All paving sealants installed, and zip strips removed where applicable.
	Comments:			
				All millwork / cabinets checked that all hardware is installed. Doors, drawers and moving parts checked for smooth operation through full range of motion. Hinges adjusted for alignment of adjacent doors.
	Comments:			

			Remove loose fasteners and debris from roofs, parking lot, and site.
Comments:			
			All door and window hardware installed by Contractor checked for missing items.
Comments:			
			All operable windows checked for smooth operation through full range of movement. Locking devices all aligned and properly engage. Screens installed where applicable.
Comments:			
			All door silencers in place. Soiled / painted silencers replaced with new.
Comments:			
			All doors / hardware installed by Contractor checked for proper operation. <i>This includes but is not limited to: Proper latching and locking operation, doors not binding on hinges or in door frames, closers and pivots adjusted to self-close and latch, and to operate in compliance with Texas Accessibility Standards, hold-opens verified adjusted for operation and release, hold-open function in closers tested where applicable, flush bolts throw fully into frames and floors, and proper operation of electronic hardware. Contractor's final submission of Contractor's punch list prior to Inspection shall include any observed deficiencies.</i>
Comments:			
			All overhead doors and other mechanically operated doors, thoroughly checked for proper adjustment and operation of all control functions, binding in tracks, and any other deficiencies. Corrections made as required.
Comments:			
			Check all ceiling tile for nicks, stains, and other damage, and replace with new as required. Check new ceiling grid for warp and damage and repair as required. Verify all tile is seated in the grid.
Comments:			
			All interior finishes work complete and ready for Architect's inspection (other than minor touch-up).
Comments:			
			All interior signage installed and accounted for.
Comments:			
			All equipment and appliances installed by Contractor tested for proper adjustment and operation.
Comments:			
			All pipes labeled as required by Contract Documents.
Comments:			
			All exposed pipe penetrations checked for sealants (fire sealant where applicable), and escutcheons, as required by Contract Documents.
Comments:			

			Remove all faucet aerators, flush lines of dirt, sand, and debris, and reinstall aerators. Test all faucet handles for correct hot and cold line connection / control.
Comments:			
			Water closets and urinal fixtures tested for proper flush operation.
Comments:			
			HVAC is functioning and humidity control is acceptable.
Comments:			
			Fans operating correctly including their controls.
Comments:			
			HVAC Filters to be replaced just prior to substantial completion with new filters.
Comments:			
			HVAC ducts checked for construction dust and debris contamination and cleaned as applicable in compliance with requirements of the Contract Documents.
Comments:			
			Electrical panels / schedules completely filled out and labeled, in compliance with Contract Documents. <i>(And other devices and circuits labeled where required by Contract Documents)</i>
Comments:			
			Check all open electrical boxes have cover plates and screws, and painted where applicable.
Comments:			
			Test all power outlets and switches.
Comments:			
			Test all data outlets (if installed by this Contract)
Comments:			
			Verify water heaters are installed with proper disconnects. [Boilers have passed State inspection.]
Comments:			
			All lighting and lighting control systems have been tested for proper operation. Vacancy and occupancy sensors adjusted to proper duration and tested for sensitivity. Debug / repair as required. Replace burned out or inoperable lamps / modules as required by Contract Documents.
Comments:			
			All landscaping, turf, and irrigation <i>(or temporary irrigation as applicable)</i> has been or will be installed / seeded by the requested date for Architect's inspection. <i>(Except as otherwise agreed or otherwise required due to planting season. Note any pending installation on Contractor's punch list.)</i>
Comments:			

2			Final Inspections All required final inspections have or will be passed by date of substantial completion (local and State). <i>Or, if any will be remaining the status will not affect Owner's beneficial occupancy and has been agreed to be acceptable by Owner.</i>
	Comments:		
3			Certificate of Occupancy A Certificate of Occupancy has been or will be issued by the requested date for inspection. <i>Or if not, a Temporary Certificate of Occupancy has been issued, and any outstanding items will not affect beneficial occupancy and are scheduled for correction and final inspection within 30 days or less.</i>
	Comments:		
4			Owner Notification Owner has been notified by Contractor with adequate time of pending changeover in utilities, insurance, and building and site security, in accordance with the Contract Documents.
	Comments:		
5			Extra Materials All extra materials, attic stock, and maintenance tools required by the construction documents to be provided by Contractor have been delivered to Owner (submit transmittals indicating each item, quantities and receipt). <i>Any outstanding extra materials not yet delivered are acceptable to Owner for beneficial occupancy and are noted in Contractor's punch list, with anticipated delivery dates.</i>
	Comments:		
6			Final Keying Final key cores and keys as applicable to project scope have or will be installed, or have been delivered Owner's installer, in time for the requested date of substantial completion. This includes all keys for any locking cabinets, lockers, toilet accessories, etc. as applicable.
	Comments:		
7			Security and Access Control Applicable intrusion detection, security camera, access control, gate operators, and similar systems required for access and security are or will be operational in time for requested date for substantial completion. <i>(Where these systems are not the installed as part of this contract, Contractor has made due effort to coordinate with Owner's separate contract or vendor for timely completion).</i>
	Comments:		
8			Owner Training All Owner training required by the Contract Documents has been scheduled with Owner, or Owner Training Conference has been conducted and Owner has agreed that any training that will not be performed by the date of substantial completion is acceptable to occur later for the purpose of achieving beneficial occupancy.
	Comments:		

9				Testing Adjusting and Balancing Report A copy of the initial HVAC TAB report has been submitted to the Architect. Indicate in comments anticipated schedule for final and opposite season TAB reports. <i>Any deficiencies in the initial report are included in Contractor's punch list, and corrections and re-testing scheduled within the allowable duration for Final Completion.</i>
	Comments:			
10				Commissioning Commissioning required by the Contract Documents has begun (and if required by Contract Documents will be complete) by the requested date of inspection. <i>Confirm coordination with Commissioning Agent. Submit most recent commissioning report to Architect, and include noted deficiencies in Contractor's punch list.</i>
	Comments:			
11				Record Drawings To the best of Contractor's knowledge, annotations on record drawings are up to date. Preliminary review copy of marked up Record Drawings has been or will be submitted to Architect for review prior to the requested date for inspection.
	Comments:			
12				Operations and Maintenance Manuals Preliminary review copy of O&M binders has been or will be submitted to Architect for review prior to the requested date for inspection.
	Comments:			
13				Record Submittals / Product Data Preliminary review copy of project Record Submittals (if required) has been or will be submitted to Architect for review prior to the requested date for inspection.
	Comments:			
14				Warranties Binder Preliminary review copy of warranties binder has been or will be submitted to Architect for review prior to the requested date for inspection.
	Comments:			
15				Roofing Manufacturer's Warranty Inspection Roofing manufacturer's inspection has been performed and Roof Warranty has been achieved by requested date for inspection. <i>Or if warranty is not achieved, only minor corrections remain to achieve warranty, and submit Manufacturer's deficiency list/report with Contractor's punch list.</i>
	Comments:			
16				[LEED] [CHPS] [Green Building Program] Requirements Paperwork and submission of data to applicable green building certification program, is up to date and complete and has been submitted to maximum extent possible, and in accordance with the Contract Documents and agreed timeline for submissions by the Contractor.
	Comments:			

17			Owner's Separate Contracts Coordination Confirm Contractor has performed required scheduling and other coordination with Owner's separate contract work as necessary to be ready for beneficial occupancy upon the requested date of Substantial Completion. This may include, but is not necessarily limited to, such things as [structured cabling and telecommunications],[A/V and IT equipment],[radio equipment],[fire station alerting system],[and FF&E delivery and installation] .
	Comments:		
18			Indoor Air Quality Program If required by Contract Documents, indoor air quality testing has been performed and passed. Or if allowed in lieu of testing, building flush-out has or will be performed by the requested date for substantial completion to the extent that flush out is required to precede occupancy; and filters will be replaced promptly as required. <i>If testing has been performed and failed, note corrective action and schedule for re-testing as applicable on Contractor's punch list.</i>
	Comments:		

END OF SECTION 01 77 00A

SECTION 01 78 23 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - 1. Operation and maintenance documentation directory.
 - 2. Emergency manuals.
 - 3. Operation manuals for systems, subsystems, and equipment.
 - 4. Product maintenance manuals.
 - 5. Systems and equipment maintenance manuals.
- B. Related Requirements:
 - 1. Division 01 Section - Multiple Contract Summary for coordinating operation and maintenance manuals covering the Work of multiple contracts.
 - 2. Division 01 Section - Submittal Procedures for submitting copies of submittals for operation and maintenance manuals.
 - 3. Division 01 Section - General Commissioning Requirements for verification and compilation of data into operation and maintenance manuals.
 - 4. Divisions 02 through 33 Sections for specific operation and maintenance manual requirements for the Work in those Sections.

1.03 DEFINITIONS

- A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.
- B. Subsystem: A portion of a system with characteristics similar to a system.

1.04 CLOSEOUT SUBMITTALS

- A. Manual Content: Operations and maintenance manual content is specified in individual Specification Sections to be reviewed at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
 - 1. Architect will comment on whether content of operations and maintenance submittals are acceptable.
 - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Format: Submit operations and maintenance manuals in the following format:
 - 1. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Architect.
 - a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
 - b. Enable inserted reviewer comments on draft submittals.
 - 2. Three paper copies. Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves.

- C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect will comment on whether general scope and content of manual are acceptable.
- D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect will return copy with comments.
 - 1. Correct or revise each manual to comply with Architect's comments. Submit three Final copies of each corrected manual within 15 days of receipt of Architect's comments and prior to commencing demonstration and training.

PART 2 - PRODUCTS

2.01 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

- A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information. Include a section in the directory for each of the following:
 - 1. List of documents.
 - 2. List of systems.
 - 3. List of equipment.
 - 4. Table of contents.
- B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
- C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
- D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

2.02 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

- A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
 - 1. Title page.
 - 2. Table of contents.
 - 3. Subcontractor list
 - 4. Manual contents.
- B. Title Page: Include the following information:
 - 1. Subject matter included in manual.
 - 2. Name and address of Project.
 - 3. Name and address of Owner.
 - 4. Date of submittal.
 - 5. Name and contact information for Contractor.
 - 6. Name and contact information for Construction Manager.
 - 7. Name and contact information for Architect.
 - 8. Name and contact information for Commissioning Authority.

9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
 10. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
- D. Subcontractor List: Organize subcontractor list by CSI specification section, as listed in the Project Manual table of contents. Provide contact name, street address (no P.O. Box numbers) and contact phone and fax number. If changes were made during the course of the project, utilize final contract company for each component of the work. List all contractors used on project, even if subcontracted to a different subcontractor, i.e; if earthwork subcontractor is contracted by the paving subcontractor, list both subcontractors.
- E. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- F. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
 2. File Names and Bookmarks: Enable bookmarking of individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.
- G. Manuals, Paper Copy: Submit manuals in the form of hard copy, bound and labeled volumes.
1. Binders: Heavy-duty, three-ring, vinyl-covered, binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 - a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
 - b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.
 2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
 3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment.
 4. Supplementary Text: Prepared on 8-1/2-by-11-inch white bond paper.
 5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.

- a. If oversized drawings are necessary, fold drawings to same size as text pages and use as foldouts.
- b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.03 EMERGENCY MANUALS

- A. Content: Organize manual into a separate section for each of the following:
 1. Type of emergency.
 2. Emergency instructions.
 3. Emergency procedures.
- B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
 1. Fire.
 2. Flood.
 3. Gas leak.
 4. Water leak.
 5. Power failure.
 6. Water outage.
 7. System, subsystem, or equipment failure.
 8. Chemical release or spill.
- C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
- D. Emergency Procedures: Include the following, as applicable:
 1. Instructions on stopping.
 2. Shutdown instructions for each type of emergency.
 3. Operating instructions for conditions outside normal operating limits.
 4. Required sequences for electric or electronic systems.
 5. Special operating instructions and procedures.

2.04 OPERATION MANUALS

- A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
 1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
 2. Performance and design criteria if Contractor has delegated design responsibility.
 3. Operating standards.
 4. Operating procedures.
 5. Operating logs.
 6. Wiring diagrams.
 7. Control diagrams.
 8. Piped system diagrams.
 9. Precautions against improper use.
 10. License requirements including inspection and renewal dates.
- B. Descriptions: Include the following:
 1. Product name and model number. Use designations for products indicated on Contract Documents.
 2. Manufacturer's name.

3. Equipment identification with serial number of each component.
 4. Equipment function.
 5. Operating characteristics.
 6. Limiting conditions.
 7. Performance curves.
 8. Engineering data and tests.
 9. Complete nomenclature and number of replacement parts.
- C. Operating Procedures: Include the following, as applicable:
1. Startup procedures.
 2. Equipment or system break-in procedures.
 3. Routine and normal operating instructions.
 4. Regulation and control procedures.
 5. Instructions on stopping.
 6. Normal shutdown instructions.
 7. Seasonal and weekend operating instructions.
 8. Required sequences for electric or electronic systems.
 9. Special operating instructions and procedures.
- D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.05 PRODUCT MAINTENANCE MANUALS

- A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- C. Product Information: Include the following, as applicable:
1. Product name and model number.
 2. Manufacturer's name.
 3. Color, pattern, and texture.
 4. Material and chemical composition.
 5. Reordering information for specially manufactured products.
- D. Maintenance Procedures: Include manufacturer's written recommendations and the following:
1. Inspection procedures.
 2. Types of cleaning agents to be used and methods of cleaning.
 3. List of cleaning agents and methods of cleaning detrimental to product.
 4. Schedule for routine cleaning and maintenance.
 5. Repair instructions.
- E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- F. Bonds: Include copies of bonds and lists of circumstances and conditions that would affect validity of bonds.
1. Include procedures to follow and required notifications for warranty claims.

2.06 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

- A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.
- B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
 - 1. Standard maintenance instructions and bulletins.
 - 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
 - 3. Identification and nomenclature of parts and components.
 - 4. List of items recommended to be stocked as spare parts.
- D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
 - 1. Test and inspection instructions.
 - 2. Troubleshooting guide.
 - 3. Precautions against improper maintenance.
 - 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - 5. Aligning, adjusting, and checking instructions.
 - 6. Demonstration and training video recording, if available.
- E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
 - 1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
 - 2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
- F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

PART 3 - EXECUTION

3.01 MANUAL PREPARATION

- A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.
- B. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- C. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

- D. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
 - 1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
 - 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- E. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
 - 1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
- F. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
 - 1. Do not use original project record documents as part of operation and maintenance manuals.
 - 2. Comply with requirements of newly prepared record Drawings in Division 01 Section - Project Record Documents.
- G. Comply with Division 01 Section - Closeout Procedures for schedule for submitting operation and maintenance documentation.

END OF SECTION 01 78 23

SECTION 01 78 39 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section includes administrative and procedural requirements for project record documents, including the following:
 - 1. Record Drawings.
 - 2. Record Specifications.
 - 3. Record Product Data.
 - 4. Miscellaneous record submittals.
- B. Related Requirements:
 - 1. Division 01 Section - Multiple Contract Summary for coordinating project record documents covering the Work of multiple contracts.
 - 2. Division 01 Section - Execution for final property survey.
 - 3. Division 01 Section - Closeout Procedures for general closeout procedures.
 - 4. Division 01 Section - Operation and Maintenance Data for operation and maintenance manual requirements.
 - 5. Divisions 02 through 33 Sections for specific requirements for project record documents of the Work in those Sections.

1.03 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit one set of marked-up record prints.
 - 2. Number of Copies: Submit copies of record Drawings as follows:
 - a. Initial Submittal:
 - 1) Submit one paper-copy set(s) of marked-up record prints.
 - 2) Submit PDF electronic files of scanned record prints and one of file prints.
 - 3) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
 - b. Final Submittal:
 - 1) Submit one paper-copy set(s) of marked-up record prints.
 - 2) Submit PDF electronic files of scanned record prints.
 - 3) Print each drawing, whether or not changes and additional information were recorded.
- B. Record Specifications: Submit one paper copy and annotated PDF electronic files of Project's Specifications, including addenda and contract modifications.
- C. Record Product Data: Submit one paper copy and annotated PDF electronic files and directories of each submittal.
 - 1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.
- D. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit one paper copy and annotated PDF electronic files and directories of each submittal.

Unless more stringent requirements are called for in other related specifications, include the following:

1. (2) copies of irrigation system laminated zone map and scanned electronic file in PDF or JPEG format.
 2. Electronic copy of Contractor's meeting minutes, and of A/E's field reports.
 3. Electronic copy of Addenda.
 4. Electronic copy of Architect's Supplemental Instructions.
 5. Electronic copy of Change Orders, Contingency Expenditures, Change Directives, and similar contract modifications.
 6. Electronic copy of Requests For Information.
 7. Electronic copy of transmittals for extra and maintenance materials, signed by Owner's representatives who received them.
 8. Attendance sign-in lists for training sessions.
- E. Reports: Submit written report indicating items incorporated into project record documents concurrent with progress of the Work, including revisions, concealed conditions, field changes, product selections, and other notations incorporated.

PART 2 - PRODUCTS

2.01 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Accurately record information in an acceptable drawing technique.
 - c. Record data as soon as possible after obtaining it.
 - d. Record and check the markup before enclosing concealed installations.
 - e. Cross-reference record prints to corresponding archive photographic documentation.
 2. Content: Types of items requiring marking include, but are not limited to, the following:
 - a. Dimensional changes to Drawings.
 - b. Revisions to details shown on Drawings.
 - c. Depths of foundations below first floor.
 - d. Locations and depths of underground utilities.
 - e. Revisions to routing of piping and conduits.
 - f. Revisions to electrical circuitry.
 - g. Actual equipment locations.
 - h. Duct size and routing.
 - i. Locations of concealed internal utilities.
 - j. Changes made by Change Order or Construction Change Directive.
 - k. Changes made following Architect's written orders.
 - l. Details not on the original Contract Drawings.
 - m. Field records for variable and concealed conditions.
 - n. Record information on the Work that is shown only schematically.
 3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
 4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.

5. Mark important additional information that was either shown schematically or omitted from original Drawings.
 6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
1. Format: Annotated PDF electronic file with comment function enabled.
 2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
 3. Refer instances of uncertainty to Architect for resolution.
- C. Newly Prepared Record Drawings: Prepare new Drawings instead of preparing record Drawings where Architect determines that neither the original Contract Drawings nor Shop Drawings are suitable to show actual installation.
1. New Drawings may be required when a Change Order is issued as a result of accepting an alternate, substitution, or other modification.
 2. Consult Architect for proper scale and scope of detailing and notations required to record the actual physical installation and its relation to other construction. Integrate newly prepared record Drawings into record Drawing sets; comply with procedures for formatting, organizing, copying, binding, and submitting.
- D. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
1. Record Prints: Organize record prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
 2. Format: Annotated PDF electronic file with comment function enabled.
 3. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."
 - d. Name of Architect.
 - e. Name of Contractor.

2.02 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
 3. Record the name of manufacturer, supplier, installer, and other information necessary to provide a record of selections made.
 4. For each principal product, indicate whether record Product Data has been submitted in operation and maintenance manuals instead of submitted as record Product Data.
 5. Note related Change Orders[, record Product Data,] and record Drawings where applicable.
- B. Format: Submit record Specifications as annotated PDF electronic file and paper copy.

2.03 RECORD PRODUCT DATA

- A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
 - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 - 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
 - 3. Note related Change Orders, record Specifications, and record Drawings where applicable.
- B. Format: Submit record Product Data as annotated PDF electronic file and paper copy.
 - 1. Include record Product Data directory organized by Specification Section number and title, electronically linked to each item of record Product Data.

2.04 MISCELLANEOUS RECORD SUBMITTALS

- A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.
- B. Format: Submit miscellaneous record submittals as PDF electronic file and paper copy.
 - 1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

PART 3 - EXECUTION

3.01 RECORDING AND MAINTENANCE

- A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.
- B. Maintenance of Record Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Architect's reference during normal working hours.

END OF SECTION 01 78 39

SECTION 01 79 00 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
 - 1. Demonstration of operation of systems, subsystems, and equipment.
 - 2. Training in operation and maintenance of systems, subsystems, and equipment.
- B. Related Requirements:
 - 1. Divisions 02 through 33 Sections for specific requirements for demonstration and training for products in those Sections.

1.03 INFORMATIONAL SUBMITTALS

- A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
 - 1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.

1.04 CLOSEOUT SUBMITTALS

- A. Transcript: Prepared and bound in format matching operation and maintenance manuals. Mark appropriate identification on front and spine of each binder. Include a cover sheet with same label information as the corresponding video recording. Include name of Project and date of video recording on each page.
- B. Transcript: Prepared in PDF electronic format. Include a cover sheet with same label information as the corresponding video recording and a table of contents with links to corresponding training components. Include name of Project and date of video recording on each page.
- C. At completion of training, submit complete training manual(s) for Owner's use prepared and bound in format matching operation and maintenance manuals.

1.05 QUALITY ASSURANCE

- A. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Division 01 Section "Quality Requirements," experienced in operation and maintenance procedures and training.
- B. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to demonstration and training including, but not limited to, the following:
 - 1. Inspect and discuss locations and other facilities required for instruction.
 - 2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
 - 3. Review required content of instruction.

4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

1.06 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.

PART 2 - PRODUCTS

2.01 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
 - a. System, subsystem, and equipment descriptions.
 - b. Performance and design criteria if Contractor is delegated design responsibility.
 - c. Operating standards.
 - d. Regulatory requirements.
 - e. Equipment function.
 - f. Operating characteristics.
 - g. Limiting conditions.
 - h. Performance curves.
 2. Documentation: Review the following items in detail:
 - a. Emergency manuals.
 - b. Operations manuals.
 - c. Maintenance manuals.
 - d. Project record documents.
 - e. Identification systems.
 - f. Warranties and bonds.
 - g. Maintenance service agreements and similar continuing commitments.
 3. Emergencies: Include the following, as applicable:
 - a. Instructions on meaning of warnings, trouble indications, and error messages.
 - b. Instructions on stopping.
 - c. Shutdown instructions for each type of emergency.
 - d. Operating instructions for conditions outside of normal operating limits.
 - e. Sequences for electric or electronic systems.
 - f. Special operating instructions and procedures.
 4. Operations: Include the following, as applicable:
 - a. Startup procedures.
 - b. Equipment or system break-in procedures.
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures.

- e. Control sequences.
- f. Safety procedures.
- g. Instructions on stopping.
- h. Normal shutdown instructions.
- i. Operating procedures for emergencies.
- j. Operating procedures for system, subsystem, or equipment failure.
- k. Seasonal and weekend operating instructions.
- l. Required sequences for electric or electronic systems.
- m. Special operating instructions and procedures.
- 5. Adjustments: Include the following:
 - a. Alignments.
 - b. Checking adjustments.
 - c. Noise and vibration adjustments.
 - d. Economy and efficiency adjustments.
- 6. Troubleshooting: Include the following:
 - a. Diagnostic instructions.
 - b. Test and inspection procedures.
- 7. Maintenance: Include the following:
 - a. Inspection procedures.
 - b. Types of cleaning agents to be used and methods of cleaning.
 - c. List of cleaning agents and methods of cleaning detrimental to product.
 - d. Procedures for routine cleaning
 - e. Procedures for preventive maintenance.
 - f. Procedures for routine maintenance.
 - g. Instruction on use of special tools.
- 8. Repairs: Include the following:
 - a. Diagnosis instructions.
 - b. Repair instructions.
 - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - d. Instructions for identifying parts and components.
 - e. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Division 01 Section "Operations and Maintenance Data."
- B. Set up instructional equipment at instruction location.

3.02 INSTRUCTION

- A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
 - 1. Owner will furnish Contractor with names and positions of participants.
- B. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
 - 1. Schedule training with Owner with at least seven days' advance notice.
- C. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.

- D. Cleanup: Collect used and leftover educational materials and remove from Project site. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

END OF SECTION 01 79 00

SECTION 02 41 19 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.
- B. General Coordination Procedures, (Reference Specification Section 01 31 00) General Contractor shall coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work that depend on each other for proper installation, connection, and operation.

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Demolition and removal of selected portions of a building or structure.
 - 2. Demolition and removal of selected site elements.
 - 3. Repair procedures for selective demolition operations.
- B. Related Sections include the following:
 - 1. Division 1 Section - Summary for use of the premises and phasing requirements.
 - 2. Division 1 Section - Work Restrictions for restrictions on use of the premises due to Owner or tenant occupancy.
 - 3. Division 1 Section - Construction Progress Documentation for preconstruction photographs taken before selective demolition.
 - 4. Division 1 Section - Temporary Facilities and Controls for temporary construction and environmental-protection measures for selective demolition operations.
 - 5. Division 1 Section - Cutting and Patching for cutting and patching procedures for selective demolition operations.
 - 6. Division 22, 23 Sections for demolishing, cutting, patching, or relocating mechanical items.
 - 7. Division 26, 27, 28 Sections for demolishing, cutting, patching, or relocating electrical items.

1.03 DEFINITIONS

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

1.04 MATERIALS OWNERSHIP

- A. Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, demolished materials shall become Contractor's property and shall be removed from Project site.
- B. Historic items, relics, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, antiques, and other items of interest or value to Owner that may be encountered during selective demolition remain Owner's property.

Carefully remove and salvage each item or object in a manner to prevent damage and deliver promptly to Owner.

1.05 SUBMITTALS

- A. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- B. Proposed Dust-Control and Noise-Control Measures: Submit statement or drawing that indicates the measures proposed for use, proposed locations, and proposed time frame for their operation. Identify options if proposed measures are later determined to be inadequate.
- C. Schedule of Selective Demolition Activities: Indicate the following:
 - 1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
 - 2. Interruption of utility services.
 - 3. Coordination for shutoff, capping, and continuation of utility services.
 - 4. Use of elevator and stairs.
 - 5. Locations of temporary partitions and means of egress.
 - 6. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
- D. Inventory: Submit a list of items to be removed and salvaged and deliver to Owner prior to start of demolition
 - 1. Inventory: After selective demolition is complete, submit a list of items that have been removed and salvaged.
- E. Predemolition Photographs or Video: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by selective demolition operations. Submit before Work begins.
- F. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.
- G. Warranties: Documentation indicated that existing warranties are still in effect after completion of selective demolition.
- H. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1.06 QUALITY ASSURANCE

- A. Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project.
- B. Professional Engineer Qualifications: Comply with Division 1 Section - Quality Requirements.
- C. Comply with all applicable federal, state and local codes and ordinances and with the requirements of insurance carriers providing coverage for this work.
- D. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- E. Standards: Comply with ANSI A10.6 and NFPA 241.

- F. Removal of existing resilient floor coverings, sheet vinyl flooring, and cutback asphaltic adhesives shall comply with the work practices recommended by the Resilient Floor Covering Institute's "Recommended Work Practices for the Removal of Resilient Floor Coverings" dated August, 1995. In addition, asbestos-containing flooring materials shall be removed in compliance with the same RFCI recommendations, and OSHA, EPA and any state and local standards or requirements.
- G. Procure and pay for all permits or certificates required for the work involved.
- H. Predemolition Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination." Review methods and procedures related to selective demolition including, but not limited to, the following:
 - 1. Inspect and discuss condition of construction to be selectively demolished.
 - 2. Review structural load limitations of existing structure.
 - 3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
 - 4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
 - 5. Review areas where existing construction is to remain and requires protection.
- I. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

1.07 FIELD CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted. Provide not less than 72 hours' notice to Owner of activities that will affect Owner's operations.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
 - 1. Before selective demolition, Owner will remove the following items:
- C. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities.
 - 1. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from authorities having jurisdiction.
- D. Owner assumes no responsibility for condition of areas to be selectively demolished.
 - 1. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
 - 2. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- E. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
 - 1. Hazardous materials will be removed by Owner before start of the Work.
 - 2. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
- F. Hazardous Materials: Hazardous materials are present in building to be selectively demolished. A report on the presence of hazardous materials is on file for review and use. Examine report to become aware of locations where hazardous materials are present.
 - 1. Hazardous material remediation is specified elsewhere in the Contract Documents.
 - 2. Do not disturb hazardous materials or items suspected of containing hazardous materials except under procedures specified elsewhere in the Contract Documents.

- G. Storage or sale of removed items or materials on-site will not be permitted.
- H. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 - 1. Maintain fire-protection facilities in service during selective demolition operations.

1.08 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.
- B. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

PART 2 - PRODUCTS

2.01 REPAIR MATERIALS

- A. Use repair materials identical to existing materials.
 - 1. If identical materials are unavailable or cannot be used for exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
 - 2. Use materials whose installed performance equals or surpasses that of existing materials.
- B. Comply with material and installation requirements specified in individual Specification Sections.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that utilities have been disconnected and capped.
- B. Review record documents of existing construction provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in record documents.
- C. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- D. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.
- E. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.
- F. Engage a professional engineer to survey condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective demolition operations.
- G. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.
- H. Steel Tendons: Locate tensioned steel tendons and include recommendations for de-tensioning.
- I. Survey of Existing Conditions: Record existing conditions by use of measured drawings preconstruction photographs
 - 1. Comply with requirements specified in Division 01 Section "Photographic Documentation".

2. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations.
3. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

3.02 UTILITY SERVICES

- A. Existing Utilities: Maintain services indicated to remain and protect them against damage during selective demolition operations.
- B. Do not interrupt existing utilities serving occupied or operating facilities unless authorized in writing by Owner and authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and to authorities having jurisdiction.
 1. Provide at least 72 hours' notice to Owner if shutdown of service is required during changeover.
- C. Utility Requirements: Locate, identify, disconnect, and seal or cap off indicated utilities serving areas to be selectively demolished.
 1. Owner will arrange to shut off indicated utilities when requested by Contractor.
 2. Arrange to shut off indicated utilities with utility companies.
 3. If utility services are required to be removed, relocated, or abandoned, before proceeding with selective demolition provide temporary utilities that bypass area of selective demolition and that maintain continuity of service to other parts of building.
 4. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.
- D. Utility Requirements: Refer to Division 21 and 28 Sections for shutting off, disconnecting, removing, and sealing or capping utilities. Do not start selective demolition work until utility disconnecting and sealing have been completed and verified in writing.

3.03 PROTECTION OF EXISTING FACILITIES

- A. The Contractor shall take all necessary precautions to insure against damage to existing work to remain in place, to be reused, or to remain the property of the Owner, and any damage to such work shall be repaired or replaced as approved by the Architect at no additional cost to the Owner.
- B. The Contractor shall carefully coordinate the work of this section with all other work and construction and maintain shoring, bracing and supports, as required.
- C. The Contractor shall insure that structural elements are not over-loaded and be responsible for increasing structural supports or adding new supports as may be required as a result of any cutting, removal, or demolition work performed under this section. Cutting and removal of structural elements shall be as specifically indicated on the architectural and structural drawings. No other cutting or removal of structural elements shall be permitted without specific approval of the Architect.
- D. Before and during site demolition operations, Contractor shall ascertain where existing utilities are located. Any damage that may occur to existing services shall be promptly corrected by the Contractor at no additional cost to the Owner.
- E. The interior of the buildings and all materials and equipment shall be protected from the weather at all times resulting from demolition for roof penetrations.

3.04 PREPARATION

- A. Dangerous Materials: Drain, purge, or otherwise remove, collect, and dispose of chemicals, gases, explosives, acids, flammables, or other dangerous materials before proceeding with selective demolition operations.
- B. Pest Control: Employ a certified, licensed exterminator to treat building and to control rodents and vermin before and during selective demolition operations.
- C. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 - 1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.
 - 2. Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction.
 - 3. Protect existing site improvements, appurtenances, and landscaping to remain.
 - 4. Erect a plainly visible fence around drip line of individual trees or around perimeter drip line of groups of trees to remain.
- D. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 - 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
 - 2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
 - 3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
 - 4. Cover and protect furniture, furnishings, and equipment that have not been removed.
 - 5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Division 01 Section "Temporary Facilities and Controls".
- E. Temporary Enclosures: Provide temporary enclosures for protection of existing building and construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
 - 1. Where heating or cooling is needed and permanent enclosure is not complete, provide insulated temporary enclosures. Coordinate enclosure with ventilating and material drying or curing requirements to avoid dangerous conditions and effects.
- F. Temporary Partitions: Erect and maintain dustproof partitions and temporary enclosures to limit dust and dirt migration and to separate areas from fumes and noise.
- G. Temporary Shoring: Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent movement, settlement, or collapse of construction to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
 - 1. Strengthen or add new supports when required during progress of selective demolition.

3.05 POLLUTION CONTROLS

- A. Dust Control: Use water mist, temporary enclosures, and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations.
 - 1. Do not use water when it may damage existing construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.

2. Wet mop floors to eliminate trackable dirt and wipe down walls and doors of demolition enclosure. Vacuum carpeted areas.
- B. Disposal: Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 1. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
- C. Cleaning: Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

3.06 SELECTIVE DEMOLITION

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
 1. Demolition work shall be in stages to accommodate Owner's occupancy requirements during the construction period; coordinate demolition schedule and operations with the Owner.
 - a. All demolition shall be coordinated with other trades to carry the work forward without interruptions.
 2. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
 3. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
 4. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 5. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
 6. Maintain adequate ventilation when using cutting torches.
 7. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
 8. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
 9. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 10. Dispose of demolished items and materials promptly.
 11. Return elements of construction and surfaces that are to remain to condition existing before selective demolition operations began.
 12. Dispose of demolished items and materials promptly. Comply with requirements in Division 01 Section "Construction Waste Management and Disposal."
- B. Existing Facilities: Comply with building manager's requirements for using and protecting elevators, stairs, walkways, loading docks, building entries, and other building facilities during selective demolition operations.
- C. Removed and Salvaged Items: Comply with the following:
 1. Clean salvaged items.

2. Pack or crate items after cleaning. Identify contents of containers.
 3. Store items in a secure area until delivery to Owner.
 4. Transport items to Owner's storage area designated by Owner.
 5. Protect items from damage during transport and storage.
- D. Removed and Reinstalled Items: Comply with the following:
1. Clean and repair items to functional condition adequate for intended reuse. Paint equipment to match new equipment.
 2. Pack or crate items after cleaning and repairing. Identify contents of containers.
 3. Protect items from damage during transport and storage.
 4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.
- F. Concrete: Demolish in small sections. Cut concrete to a depth of at least 3/4 inch at junctures with construction to remain, using power-driven saw. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete indicated for selective demolition. Neatly trim openings to dimensions indicated.
- G. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.
- H. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.
- I. Where existing ceramic tile and brick tile is indicated to be removed at existing partitions and substrate scheduled to receive a new layer of gypsum board, the tile shall be carefully removed and the substrate prepared to receive a new gypsum board.
- J. Where finish flooring is indicated to be removed, the flooring, including the mastic, shall be completely removed and the substrate prepared to receive the new flooring.
1. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI-WP and its Addendum.
 - a. Remove residual adhesive and prepare substrate for new floor coverings by one of the methods recommended by RFCI.
 - b. Asbestos-containing flooring materials shall be removed in compliance with the RFCI recommended work practices, and OSHA, EPA and any state and local standards or requirements.
 2. Where finish ceramic/quarry tile flooring is indicated to be removed, the flooring including the cement setting bed shall be completely removed and the concrete substrate prepared to receive a new cement setting bed for finish indicated.
- K. Roofing: Remove no more existing roofing than can be covered in one day by new roofing. Refer to applicable Division 7 Section for new roofing requirements.
1. Remove existing roof membrane, flashings, copings, and roof accessories.
 2. Remove existing roofing system down to substrate.
- L. Air-Conditioning Equipment: Remove equipment without releasing refrigerants.
- M. Refrigerant: Remove refrigerant from mechanical equipment to be selectively demolished according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.07 PATCHING AND REPAIRS

- A. General: Promptly repair damage to adjacent construction caused by selective demolition operations.
- B. Patching: Comply with Division 1 Section "Cutting and Patching."
- C. Repairs: Where repairs to existing surfaces are required, patch to produce surfaces suitable for new materials.
 - 1. Completely fill holes and depressions in existing masonry walls that are to remain with an approved masonry patching material applied according to manufacturer's written recommendations.
- D. Finishes: Restore exposed finishes of patched areas and extend restoration into adjoining construction in a manner that eliminates evidence of patching and refinishing.
- E. Floors and Walls: Where walls or partitions that are demolished extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish color, texture, and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - 1. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections of these Specifications.
 - 2. Where patching occurs in a painted surface, apply primer and intermediate paint coats over patch and apply final paint coat over entire unbroken surface containing patch. Provide additional coats until patch blends with adjacent surfaces.
 - 3. Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
- F. Ceilings: Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.

3.08 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site.
 - 1. Do not allow demolished materials to accumulate on-site.
 - 2. Remove & transport debris in a manner that prevents spillage on adjacent surfaces and areas.
 - 3. Comply with requirements specified in Division 01 Section "Construction Waste Management and Disposal."
- B. Burning: Do not burn demolished materials.
- C. Disposal: Transport demolished materials and dispose of at designated spoil areas on Owner's property.
- D. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.09 CLEANING

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

3.10 SELECTIVE DEMOLITION SCHEDULE

- A. Existing Items to Be Removed: Paving
- B. Existing Items to Be Removed and Salvaged:

C. Existing Items to Be Removed and Reinstalled: Light Poles, Fire Hydrants, Signage, Irrigation

D. Existing Items to Remain: Signage, Power Poles, Light Poles

END OF SECTION 02 41 19

SECTION 03 11 00 - CONCRETE FORMWORK

PART 1 - GENERAL

1.01 REFERENCED DOCUMENTS

- A. The Drawings, Division 01 Specifications, and General Provisions and General and Supplemental Conditions of the Contract apply to work of this Section.

1.02 WORK INCLUDED

- A. Design, fabrication, erection, and stripping of formwork for cast-in-place concrete including shoring, reshoring, falsework, bracing, proprietary forming systems, prefabricated forms, void forms, permanent metal forms, bulkheads, keys, blockouts, sleeves, pockets, and accessories. Erection shall include installation in formwork of items furnished by other trades.

1.03 RELATED SECTIONS

- A. Division 01 Section - Quality Requirements for Testing Laboratory Services.
- B. Division 03 Section - Reinforcing Steel.
- C. Division 03 Section - Cast in Place Concrete.
- D. Division 03 Section - Architectural Concrete.
- E. Division 32 Section - Portland Cement Concrete Paving.

1.04 REFERENCES

- A. The latest adopted edition of all standards referenced in this section shall apply, unless noted otherwise:
 - 1. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials.
 - 2. ACI 301 - Specifications for Structural Concrete for Buildings.
 - 3. ACI 347R - Guide to Formwork for Concrete.
 - 4. ACI SP-4 - Formwork for Concrete.

1.05 QUALITY ASSURANCE

- A. Construct and erect concrete formwork in accordance with ACI 117, 301 and 347R.
- B. Forms, shores, reshores, falsework, bracing, and other temporary supports shall be designed by the Contractor to support all loads imposed during construction including weight of construction equipment, live loads, and lateral loads due to wind and imbalance or discontinuity of building components.
- C. The Contractor shall be responsible for determining when temporary supports and bracing may be safely removed, but in no case shall the curing time before form removal be less than specified herein.

1.06 TOLERANCES

- A. Construct formwork to provide completed concrete surfaces complying with the following tolerances:
 - 1. Vertical alignment:
 - a. Lines, surfaces and arises less than 100 feet in height - 1 inch.
 - b. Outside corner of exposed corner columns and control joints in concrete exposed to view less than 100 feet in height - 1/2 inch.

2. Lateral alignment:
 - a. Members - 1 inch.
 - b. Centerline of openings 12 inches or smaller and edge location of larger openings in slabs - 1/2 inch.
 - c. Sawcuts, joints, and weakened plane embedments in slabs - 3/4 inch.
3. Level alignment:
 - a. Elevation of slabs-on-grade - 3/4 inch.
 - b. Elevation of top surfaces of formed slabs before removal of shores - 3/4 inch.
 - c. Elevation of formed surfaces before removal of shores - 3/4 inch.
 - d. Lintels, sills, parapets, horizontal grooves, and other lines exposed to view - 1/2 inch.
4. Cross-sectional dimensions: Overall dimensions of beams, joists, and columns and thickness of walls and slabs.
 - a. 12 inch dimension or less - plus 3/8 inch to minus 1/4 inch.
 - b. Greater than 12 inch to 3 foot dimension - plus 1/2 inch to minus 3/8 inch.
 - c. Greater than 3 foot dimension - plus 1 inch to minus 3/4 inch.
5. Relative alignment:
 - a. Stairs:
 - 1) Difference in height between adjacent risers - 1/8 inch.
 - 2) Difference in width between adjacent treads - 1/4 inch.
 - 3) Maximum difference in height between risers in a flight of stairs - 3/8 inch.
 - 4) Maximum difference in width between treads in a flight of stairs - 3/8 inch.
 - b. Vertical alignment of outside corner of exposed corner columns and control joint grooves in concrete exposed to view - 1/4 inch in 10 feet.
 - c. All other conditions - 3/8 inch in 10 feet.
 - d. Offsets between pieces of formwork facing material:
 - 1) Class A - Architecturally or prominently exposed surfaces - 1/8 inch gradual or abrupt.
 - 2) Class B - Surfaces to receive plaster or stucco - 1/4 inch gradual or abrupt.
 - 3) Class C - Exposed surfaces in generally unfinished spaces - 1/4 inch abrupt, 1/2 inch gradual.
 - 4) Class D - Concealed surfaces - 1 inch gradual or abrupt.

1.07 SUBMITTALS

- A. See Division 01 Section - Submittal Procedures for submittal procedures.
- B. Submittals for Review:
 1. Shop drawings for fabrication and erection of forms for concrete surfaces architecturally exposed to view. Show general construction of forms including jointing and special formed joints or reveals, location and pattern of form tie placement, inserts and anchorages, and other items which visually affect exposed concrete.
 2. Samples of chamfer strips, form liners, form ties, and other items which visually affect exposed concrete.
- C. Submittals for Information:
 1. Submit manufacturer's product data and installation instruction for proprietary materials used in exposed concrete work including form liners, release agents, form systems, ties, and accessories.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver form materials in manufacturer's packaging with installation instructions.

- B. Store off ground in ventilated and protected area to prevent deterioration from moisture or damage.

PART 2 - PRODUCTS

2.01 FORM MATERIALS

- A. Forms for Unexposed Concrete:
 - 1. Construct formwork of plywood, lumber, metal, or other acceptable material. Lumber shall be dressed on at least two edges and one side for tight fit.
- B. Formed Voids under Grade Beams: Corrugated fiberboard box forms, in size indicated on drawings and rated to sustain a load exceeding the total weight of fresh concrete placed over the voids in addition to anticipated construction loads and as manufactured by;
 - 1. VoidForm Products, Inc.
 - 2. approved equal
- C. Forms for Exposed Concrete:
 - 1. Construct formwork with plywood, metal, or other panel type materials designed to provide continuous straight and smooth as-cast surfaces with minimum number of joints. Joints shall be made tight and shall be backed so that edges of adjoining formwork remain flush. Joints shall be vertical or horizontal, unless noted otherwise.
 - 2. Wood forms shall be constructed of 3/4 inch, APA B-B Plyform, Class 1, Exterior conforming to PS-1. Panels shall be mill oiled and all edges shall be sealed.
- D. Forms for Architecturally Exposed Concrete:
 - 1. Construct formwork with plywood, metal, or other panel type materials designed to provide continuous straight and smooth as-cast surfaces with minimum number of joints. Joints shall be made tight and shall be backed so that edges of adjoining formwork shall remain flush and true. Joints shall be vertical or horizontal, unless noted otherwise.
 - 2. Forms shall be constructed from one of the following:
 - a. Plywood: 3/4 inch, APA High Density Overlay (HDO), Exterior conforming to PS-1. All edges shall be sealed.
 - b. Plastic Faced Plywood: 3/4 inch, APA A-C, Class 1, Exterior conforming to PS-1 faced with high density polyethylene or PVC sheet. All edges shall be sealed.
 - c. Steel: 3/16 inch smooth blue mill plate steel, well matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces. All joints shall be welded full and ground smooth and flush with surrounding surfaces.
 - d. Glass Fiber Reinforced Plastic Forms: Matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to structural tolerances and appearance of finished concrete surface.
- E. Cylindrical Forms:
 - 1. Forms to be used at exposed columns, light pole bases and other exposed cylindrical concrete locations, shall be constructed from one of the following:
 - a. Paper or Fiber Tubes: Standard ((Seamless)) plastic-lined units furnished full length without splices.
 - b. Steel: Thickness and sufficient backing to prevent bulges and warps. Provide units to minimize joints. Seal and finish joints so joints are not visible in finished concrete. Units shall be free of bends, dents, holes, and rust.
 - c. Glass Fiber Reinforced Plastic Forms: Thickness and sufficient backing to prevent bulges and warps. Provide units to minimize joints. Seal and finish joints so joints are not visible in finished concrete. Units shall be free of bends, dents, and holes.

2.02 FORMWORK ACCESSORIES

- A. Form Ties: Removable or snap-off metal of adjustable length; cone type; one inch break back dimension; free of defects that will leave holes larger than one inch diameter in concrete surface.
- B. Form Release Agent: Colorless material which will not stain concrete, absorb moisture, or impair natural bonding or color characteristics of coating intended for use on concrete.
- C. Rustications, Bevels and Chamfers: Steel, polyvinyl chloride, or milled and sealed wood of size and shape shown on the Drawings.
- D. Protection Board: For use over void forms under structural slabs. Hard-pressed cellulose fiber board, 1/4 inch minimum thickness, or "SureCover Board", as manufactured by VoidForm Products, Inc.
- E. Sleeves and Blockouts: Formed with galvanized metal, galvanized pipe, polyvinyl chloride pipe, fiber tubes, or wood.
- F. Nails, Spikes, Lag Bolts, Through Bolts, and Anchorages: Sized as required; of strength and character to maintain formwork in place while placing concrete.

PART 3 - EXECUTION

3.01 FORM CONSTRUCTION

- A. General: Construct forms to the sizes, shapes, lines and dimensions shown on the Drawings. Provide for openings, offsets, keyways, rustications, reglets, chamfers, blockouts, bulkheads, anchorages, inserts, and other features as required. Form all openings in concrete slabs as required for the vertical passage of ducts, pipes, conduits, etc.. The design and engineering of the formwork, as well as its construction, shall be the responsibility of the Contractor. Adequately shore all concrete members to safely support all loads and lateral pressures outlined in "Recommended Practice for Concrete Formwork" (ACI 347) without distortion, excessive deflection or other damage.
- B. Construction forms shall be provided for any and all items of concrete work required for or in connection with the satisfactory completion of the project, whether each such item is specifically shown or referred to or not.
- C. Fabricate formwork for easy removal without hammering or prying against concrete surfaces. Form removal shall be accomplished as a hand operation, with due care to avoid damage to any finished concrete work or any reinforcing passing through forms being removed.
- D. Kerf wood inserts as required for ease of removal.
- E. Provide temporary ports in formwork to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain. Close ports with tight fitting panels, flush with inside face of forms, neatly fitted so that joints will not be apparent in exposed concrete surfaces.
- F. Fit forms placed for successive concrete placements for continuous surfaces, to accurate alignment, and within allowable tolerances.
- G. Minimize form joints. Symmetrically align joints and make watertight to prevent leakage of mortar. Should construction joints prove to be absolutely unavoidable, locate such joints within the middle third of spans or as detailed on the drawings. Make no additional construction joints

- under any circumstances without the written approval of the Architect. Provide appropriate keys in all construction joints, whether horizontal or vertical.
- H. Form intersecting planes to provide true corners with edge grain of plywood not exposed as form for concrete.
 - I. Erect, support, brace, and maintain falsework to safely support all applied loads until such loads can be supported by the concrete structure.
 - J. Construct formwork to cambers shown or specified on the Drawings to allow for structural deflection of the hardened concrete. Provide additional elevation or camber in formwork as required for anticipated formwork deflections due to weight and pressures of concrete and construction loads.
 - K. Forms for Exposed Concrete:
 - 1. Drill forms from the contact face to the outside to suit form ties used. Do not splinter forms by driving ties through improperly prepared holes.
 - 2. Provide sharp, clean corners at intersecting planes without visible edges or offsets. Back joints with extra studs or girts if required to maintain corners.
 - 3. Provide extra studs, girts, walers, and bracing to prevent bowing of forms.
 - 4. Form shapes, recesses and projections with smooth finish materials, and install in forms with sealed joints.
 - 5. Locate form ties in level horizontal rows, plumbed vertically, and in symmetrical arrangements, unless noted otherwise.
 - 6. Special care shall be given to formwork, ties, bracing, etc. for any concrete surface to be left exposed to permanent view. Waves, bulges, form marks, staining, joint marks or irregularities shall be considered unacceptable.
 - L. Corner Treatment: Form exposed corners of beams, walls and columns with chamfered edges, unless noted or shown otherwise.
 - 1. Form chamfers with 3/4 inch by 3/4 inch strips, unless noted otherwise.
 - 2. Unexposed corners may be formed square or chamfered.
 - M. Foundation Elements: The sides of all below grade portions of beams, pier caps, walls, and columns shall be formed straight and to the lines and grades specified.

3.02 APPLICATION OF FORM RELEASE AGENT

- A. Apply form release agent on formwork in accordance with manufacturer's instructions. Apply prior to placing reinforcing steel, anchoring devices, and embedded items.
- B. Do not apply form release agent where concrete surfaces are scheduled to receive subsequent finishes which may be affected by agent. Soak contact surfaces of untreated forms with clean water. Keep surfaces wet prior to placing concrete.

3.03 INSERTS, EMBEDDED PARTS, AND OPENINGS

- A. Provide formed openings where required for work embedded in or passing through concrete. In case of conflict with reinforcing steel or structural embeds, consult Architect before placement.
- B. Coordinate work of other Sections in forming and setting openings, slots, recesses, chases, sleeves, bolts, anchors, and other inserts.
- C. Install accessories in accordance with manufacturer's instructions, level and plumb. Ensure items are not disturbed during concrete placement.

3.04 FORM REMOVAL

- A. Formwork not supporting concrete, such as side forms for beams, walls, and columns, may be removed after cumulatively curing at not less than 50 degrees Fahrenheit (10 degrees Celsius) for 12 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form removal, and provided curing and protection operations are maintained.

- B. Formwork supporting conventionally reinforced concrete shall not be removed until concrete has attained 85 percent of its specified 28 day compressive strength as established by tests of field cured cylinders. In the absence of cylinder tests, supporting formwork shall remain in place until the concrete has cured at a temperature of at least 50 degrees Fahrenheit (10 degrees Celsius) for the minimum cumulative time periods given in ACI 347, Section 3.7.2.3. When the surrounding air temperature is below 50 degrees Fahrenheit (10 degrees Celsius), that time period shall be added to the minimum listed time period. Formwork for two-way conventionally reinforced slabs shall remain in place for at least the minimum cumulative time periods specified for one-way slabs of the same maximum span.
- C. Minimum cumulative curing times may be reduced by the use of high-early strength cement or forming systems which allow form removal without disturbing shores, but only after the Contractor has demonstrated to the satisfaction of the Architect that the early removal of forms will not cause excessive sag, distortion or damage to the concrete elements.
- D. Wood forms shall be completely removed. Provide temporary openings if required.
- E. Provide adequate methods of curing and thermal protection of exposed concrete if forms are removed prior to completion of specified curing time.
- F. Areas required to support construction loads in excess of 20 psf shall be reshored to properly distribute construction loading. Construction loads up to the rated live load capacity may be placed on unshored construction provided the concrete has attained the specified 28 day compressive strength.
- G. Obtaining concrete compressive strength tests for the purposes of form removal shall be the responsibility of the Contractor.

3.05 SHORES AND RESHORES FOR MULTILEVEL STRUCTURES

- A. Comply with ACI 347 and these specifications regarding shoring and reshoring.
- B. The Contractor shall be solely responsible for proper shoring and reshoring.
- C. Extend shores or reshores from ground to top level in structure three stories or less in height, unless noted otherwise.
- D. In crawl spaces or basements, shores or reshores shall extend to mud pads seated firmly on the soil or to on-grade construction.
- E. All levels of reshores may be removed after formwork for the uppermost floor has been removed in accordance with these specifications.

3.06 REUSE OF FORMS

- A. Clean and repair surfaces of forms to be reused. Damaged forming material shall not be replaced and shall not be used in construction.
- B. Apply form release agent to concrete contact surfaces prior to each reuse of the forms.

3.07 CLEANING

A. Upon completion of work of this section, remove related debris from job site.

END OF SECTION 03 11 00

SECTION 03 20 00 - CONCRETE REINFORCEMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Includes furnishing all materials, equipment, transportation and facilities and performing all labor necessary for the following:
 - 1. Prepare shop drawings of reinforcing steel.
 - 2. Furnish and place reinforcing steel.
 - 3. Fabrication and installation of embedded metal assemblies.
- B. Related Documents: The Contract Documents, as defined in Division 01 Section - Summary of Work, apply to the Work of this Section. Additional requirements and information necessary to complete the Work of this Section may be found in other Documents.
- C. Related Sections include the following:
 - 1. Division 01 Section - Quality Requirements.
 - 2. Division 03 Section - Concrete Formwork.
 - 3. Division 03 Section - Cast-in-Place Concrete.
 - 4. Division 03 Section - Tilt-Up Concrete.
 - 5. Division 31 Section - "Drilled Piers.

1.03 SUBMITTALS

- A. Division 01 Section - Submittal Procedures: Procedures for submittals.
- B. Shop Drawings: Submit shop and installation drawings of reinforcement and embedded metal assemblies for review by the Engineer. Reproduce the bar bending diagram, the beam, slab and joist notes and cast-in-place concrete notes that concern the proper placing of reinforcing and submit it with each set of shop drawings for field use. Use same bar marks on bar bending diagrams as used on the beam, and slab schedule. Use same beam, and wall marks as Contract Documents.
- C. Mill Test Reports: Deliver certified copies, evidencing compliance with all requirements of these specifications to the Engineer with all deliveries of reinforcing steel.
- D. Submit copies of laboratory inspection reports as follows:
 - 1. Steel Supplier - 1 Copy
 - 2. General Contractor - 1 Copy
 - 3. Owner - 1 Copy
 - 4. Architect - 1 Copy
 - 5. Structural Engineer - 1 Copy

1.04 LABORATORY TESTING AND INSPECTION

- A. Inspect welding of deformed bar anchors at the beginning of each period of production for size, length and quality. Re-inspect corrected welds.

- B. Reinforcing: inspect all reinforcing steel prior to placement of concrete for compliance with the Contract Documents and the approved shop drawings. All instances of noncompliance shall be immediately brought to the attention of the Contractor. If uncorrected by the contractor, they shall be listed in the report.
 - 1. Observe and report the following: number and size of bars; bending; splicing; clearance to forms; clearance between bars; rust, form oil or other contamination; fabrication and installation of embedded metal assemblies, including visual inspection of all welds.
- C. Inspector shall have a minimum of three years of experience inspecting reinforcing steel in projects of similar size.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Reinforcing: All of domestic manufacturers.
 - 1. Bars: New deformed billet steel, ASTM A-615, grade 60.
 - 2. Reinforcing bars to be welded: ASTM A706; Bars shall have a carbon content not exceeding 0.30% and a manganese content not exceeding 0.60%. Provide certified copies of the ladle analysis for each lot of bars to be welded.
 - 3. Welded Wire Fabric: "Specification for Steel Welded Wire Fabric" (ASTM A185) with yield strength $F_y=60,000$ psi.
 - 4. Epoxy coated reinforcing bars: Not used
- B. Fiber reinforcing: Not Used
- C. Concrete accessories including bar supports, chairs, spacers, etc.: Cold-drawn wire and fabricated in accordance with the requirements of Chapter Seven of the ACI Standard 315 with heights as required.
- D. Bar supports for concrete resting on earth: Precast concrete briquettes having tie wires embedded therein, or individual high chairs No. HCP with welded plates on bottom as manufactured by Hohmann & Barnard, Inc. Provide bar supports, hot-dipped galvanized after fabrication, where concrete will be exposed including ceilings of flat slabs.
- E. Bar supports for reinforcing placed over carton forms to be of type to prevent puncturing the carton form.

2.02 METAL ANCHORAGE & CONFINEMENT ASSEMBLIES

- A. Steel bars, plates, angles and miscellaneous steel: ASTM A36
- B. Welded Deformed Bar Anchors: Welded by full-fusion process; "Nelson" Anchors Type D2L or approved equal conforming to ASTM A496 and AWS D1.1
- C. Headed Stud Anchors: Headed Studs welded by full fusion process as furnished by Nelson Stud Welding Company or approved equal, conforming to AWS D1.1 Section 7, Type A.
- D. Bolts: Conform to ASTM F1554 with regular hexagon nuts and carbon steel washers.
- E. Straps: Conform to ASTM A245 or A284.
- F. Welding Electrodes: ASTM Designation A233, Series E70 - AWS 5.5.

2.03 FABRICATION

- A. Fabricate reinforcing steel in compliance with the CRSI "Manual of Standard Practice".
- B. All bar splices shall be a minimum of Class "A" lap unless specified otherwise on drawings.

- C. Shop-fabricate reinforcing bars to conform to the required shapes and dimensions, with fabrication tolerances complying with ACI 315. In case of fabricating errors, do not re-bend or straighten reinforcement in a manner that will injure or weaken the material.
- D. Deliver all reinforcement to the project site bundled, tagged and marked. Use metal tags indicating bar size, lengths, and other information corresponding to markings shown on placement diagrams.
- E. Reinforcing with any of the following defects will not be permitted in the work: Bar lengths, depths, and bends exceeding the specified fabrication tolerances, bends or kinks not indicated on drawings or final shop drawings, bars with reduced cross-section due to excessive rusting or other cause.

2.04 COATING

- A. Rust inhibitor for field application to metal accessories shall be Hi-Build Epoxoline manufactured by the TNEMEC Co., Kansas City, Missouri or approved equal.
- B. Hot dip galvanizing shall conform to ASTM A123.
- C. Cold Galvanizing Compound for field repair of galvanizing shall be "ZRC Cold Galvanizing Compound" by ZRC Chemical Products Company, Quincy, Massachusetts, or approved equal.

PART 3 - EXECUTION

3.01 MATERIAL STORAGE

- A. Stack reinforcing steel in tiers. Exercise care to maintain all reinforcement free of dirt, mud, paint, rust, etc.

3.02 GENERAL

- A. Place reinforcing steel of the sizes, shapes, lengths, spacing and other dimensions where shown on the drawings. Details of reinforcing shall conform to the ACI Building Code Requirements for Structural Concrete (ACI 318-14).

3.03 MARKING

- A. Mark bars plainly. Limit bundles to 1 size and 1 length and tag each bundle with metal tags.

3.04 CLEANING

- A. Clean reinforcement thoroughly of rust, mill scale, dirt, oil or other coatings which might tend to reduce the bonding to the concrete.

3.05 BENDING

- A. Bend bars cold. Heating of reinforcement, or handling by makeshift methods, will not be permitted and bars having kinks or bends not required will be rejected.

3.06 PLACING

- A. Comply with the specified codes and standards, and the Concrete Reinforcing Steel Institute recommended practice for "Placing Reinforcing Bars", for details and methods of reinforcement placement and supports, and as herein specified.
- B. Place reinforcement accurately, securely saddle tie at every other intersection with No. 18 gauge black annealed wire, and rigidly hold in place during the placing of the concrete by means of metal chairs or spacers.
- C. Hold bars in position and to proper clearance of concrete surface by spacers, chairs, or other necessary supports with the following tolerances:
 - 1. Top bars in slabs and beams:

- a. Members 8" deep or less: $\pm 3/8"$
- b. Members more than 8" but not over 2' deep: $\pm 1/2"$
- c. Members more than 2': $\pm 3/4"$
- 2. Lengthwise of members: $\pm 2"$
- 3. Concrete cover to formed surfaces: $\pm 1/4"$
- 4. Minimum spacing between bars: $\pm 1/4"$

3.07 CONCRETE PROTECTION

- A. Minimum protection for reinforcing steel shall be as follows:
 - 1. Concrete cast against and permanently exposed to earth: 3"
 - 2. Concrete exposed to earth or weather or cast in place against a vapor retarder
 - a. #6 thru #18 bars: 2"
 - b. #5 bars and smaller: 1 1/2"
 - 3. Concrete not exposed to weather or in contact with the ground:
 - a. Slabs, walls, joists with #14 & #18 bars: 1 1/2"
 - b. Slabs, walls, joists with #11 bars and smaller: 3/4"
 - c. Beam and column primary reinforcement, ties, stirrups, and spirals: 1 1/2"

3.08 EMBEDDED METAL ASSEMBLIES

- A. Fabricate and assemble structural steel items in the shop. Shearing, flame cutting, and chipping shall be done carefully and accurately. Holes shall be cut, drilled, or punched at right angles to the surface of the metal and shall not be made or enlarged by burning. Welded construction shall conform to the AISC Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings and AWS D1.1. Welding shall be done by AWS certified welders.
- B. Welding of deformed bar anchors and headed stud anchors shall be done by full-fusion process equal to that of Nelson Stud Welding Company.

END OF SECTION 03 20 00

SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Cast-in-place (CIP) concrete in building frame elements, walls, foundations, foundation walls, slabs-on-ground, and mechanical equipment pads.
 - 2. Finishing of concrete floor slabs and toppings. Concrete liquid surface treatment, sealer, and slip-resistant coatings.
 - 3. Mix Designs
 - 4. Expansion and contraction, control joints in CIP concrete.
 - 5. Concrete curing and protection.
 - 6. Non-shrink grout including installation and forming.
- B. Related Sections:
 - 1. Division 03 Section - Concrete Forms and Accessories.
 - 2. Division 03 Section - Concrete Reinforcement.
 - 3. Division 03 Section - Polished Concrete Floor Finishing, for additional requirements for slabs to receive polished finish.

1.03 REFERENCES

- A. American Association of State Highway and Transportation Officials (AASHTO)
 - 1. AASHTO M182
- B. American Concrete Institute (ACI):
 - 1. ACI 121R, "Quality Assurance Systems for Concrete Construction."
 - 2. ACI 301, "Specification for Structure /Concrete."
 - 3. ACI 302.1R, "Guide for Concrete Floor and Slab Construction."
 - 4. ACI 304.2-R, "Placing Concrete by Pumping Methods."
 - 5. ACI 305, "Hot Weather Concreting."
 - 6. ACI 306, "Cold Weather Concreting."
 - 7. ACI 315, "Manual of Standard Practice for Detailing Concrete Structures."
 - 8. ACI 347, "Recommended Practice for Concrete Formwork."
 - 9. ACI 503.2, "Standard Specification for Bonding Plastic Concrete to Hardened Concrete with a Multi-Component Epoxy Adhesive."
 - 10. ACI SP-15, "Field Reference Manual" which includes ACI 301 "Specifications for Structural Concrete for Buildings" and reference standards specified therein.
 - 11. ACI 318-08, "Building Code Requirements for Structural Concrete."
- C. American Welding Society (AWS)
 - 1. AWS D1.4, "Structural Welding Code Reinforcing."
- D. American Society for Testing and Materials (ASTM).
 - 1. ASTM A615, "Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement."
 - 2. ASTM C33, "Specification for Concrete Aggregates."
 - 3. ASTM C39, "Test Method for Compressive Strength of Cylindrical Concrete Specimens."
 - 4. ASTM C94, "Specification for Ready-Mixed Concrete."

5. ASTM C114, "Test Method for Chemical Analysis of Hydraulic Cement."
 6. ASTM C138, "Test Method for Unit Weight, Yield, and Air Content of Concrete."
 7. ASTM C143, "Test Method for Slump of Hydraulic Cement."
 8. ASTM C150, "Specification for Portland Cement."
 9. ASTM C156, "Test Method for Water Retention by Concrete Curing Materials."
 10. ASTM C171, "Specification for Sheet Materials for Curing Concrete."
 11. ASTM C173, "Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method."
 12. ASTM C227, "Test Method for Potential Alkali Reactivity of Cement-Aggregate Combinations."
 13. ASTM C231, "Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method."
 14. ASTM C260, "Specification for Air Entraining Admixtures for Concrete."
 15. ASTM C309, "Specification for Liquid Membrane-Forming Compounds for Curing Concrete."
 16. ASTM C311, "Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use as a Mineral Admixture in Portland-Cement Concrete."
 17. ASTM C387, "Specification for Packaged, Dry, Combined Materials for Mortars and Concrete."
 18. ASTM C494, "Specification for Chemical Admixtures for Concrete."
 19. ASTM C618, "Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete."
 20. ASTM C685, "Specification for Concrete Made by Volumetric Batching and Continuous Mixing."
 21. ASTM C989, "Specification for Ground Iron Blast-Furnace Slag for Use in Concrete and Mortars."
 22. ASTM E154, "Test Methods for Water Vapor Retarders Used in Contact with Earth Under Slabs, On Walls, or as Ground Cover."
 23. ASTM E1155, "Test Method for Determining Floor Flatness and Levelness Using The F-Number System."
 24. ASTM D2240, "Standard Test Method for Rubber Property-Durometer Hardness."
- E. Concrete Reinforcing Steel Institute (CRSI),
1. CRSI "Manual of Standard Practice."

1.04 SUBMITTALS

- A. Product Data:
1. Manufacturers' literature containing product and installation specifications and details.
 2. Where Manufacturer's specifications, recommendations, and/or directions are required by this specification, include Manufacturer's specifications, recommendations, and/or directions.
- B. Shop Drawings: All shop drawings and calculations must bear the seal and signature of an engineer registered in the jurisdiction where project is being constructed.
1. Cast-in-place concrete shown on structural drawings, prepared under the supervision of a registered Professional Engineer, including:
 - a. Rebar placing drawings (ACI 315-99, Detailing Manual SP-66-80 or CRSI MSP-2-81 "Manual of Standard Practice): Show bar sizes, spacing, locations, and quantities of reinforcing and wire fabric and supporting and spacing accessories. Provide steel order lists including bending and cutting details for all reinforcement shown on the structural design drawings. Provide plans showing beam and pier marks associated with schedules.
 - b. Form construction details, including jointing, special formed joints or reveals, location and pattern of form tie placement, and other items that affect exposed concrete visually.

- c. Calculations for any formwork, shoring and/or reshoring.
- 2. Slab Construction Joint Layout: Unless all concrete control and expansion joints in paving are specifically indicated in Drawings, submit complete joint layout indicating proposed construction joint locations to comply with spacing requirements.
 - a. Location of joints is subject to approval of Architect and Structural Engineer.
- 3. Concrete Paving Joint Layout: Unless all concrete control and expansion joints in paving are specifically indicated in Drawings, submit complete joint layout indicating proposed construction joint locations to comply with spacing requirements.
 - a. Location of joints is subject to approval of Architect and Civil Engineer.
- C. Concrete design mixes: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
 - 1. Indicate amounts of mixing water to be withheld for later addition at Project site.
- D. Informational Submittals:
 - 1. Test Reports: Submit the following reports directly to Architect from Testing Laboratory, with copy to Contractor. Prepare reports in conformance with Division 01 Section - Quality Requirements:
 - a. Submit laboratory test reports for concrete materials and mix design test, including certified copy of results of aggregate tested by ASTM C227.
 - 2. Certificates: Manufacturer's certificate that Products meet or exceed specified requirements.
 - 3. Qualification Documentation: Submit documentation of experience indicating compliance with specified qualification requirements.
 - 4. Failure by the contractor to submit the shop drawings, test reports and/or mix designs required above shall release the architect and the engineer from any liabilities due to the negligence on the part of the contractor to comply with the construction documents.

1.05 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Manufacturer: Company specializing in manufacturing Products specified with minimum 5 years documented experience.
 - 2. Installer: Company specializing in performing the Work of this Section with minimum 5 years documented experience.
 - 3. Testing Agency: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
 - 4. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4.
- B. Pre-Installation Meetings: Convene a pre-installation meeting at least one week prior to commencing Work of this Section. Require attendance of parties directly affecting Work of this Section.
 - 1. Review conditions of operations, procedures and coordination with related Work.
 - 2. Agenda shall include the following, as applicable to project scope:
 - a. Tour, inspect, and discuss conditions of concrete work.
 - b. Review concrete testing and their requirements.
 - c. Review required submittals, both completed and yet to be completed.
 - d. Review Drawings.
 - e. Review tolerances and slab flatness requirements.
 - f. Review any special conditions.
 - g. Review requirements for concrete finishes.
 - h. Approve proposed equipment.
 - i. Review and finalize construction schedule related to concrete work and verify availability of materials, personnel, equipment, and facilities needed to make progress and avoid delays.

- j. Review required inspections, testing, certifying, and material usage accounting procedures.
 - k. Review weather and forecasted weather conditions, and procedures for coping with unfavorable conditions.
 - l. Review safety precautions relating to concrete work operations.
 - m. Environmental procedures.
3. General Contractor shall record minutes to include decisions made, action items, and other important points of discussion. Contractor shall distribute minutes to meeting participants, Architect, and other affected parties within 3 business days of the meeting.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Transport, handle, store, and protect Products in accordance with Manufacturers' and Division 01 requirements.
- B. Deliver materials in unopened containers with labels identifying contents.
- C. Store powdered materials in dry area and in manner to prevent damage. Protect liquid materials from freezing.

1.07 PROJECT CONDITIONS

- A. Testing: Owner will engage a qualified testing agency to perform pre-construction testing on concrete mixtures. Contractor shall coordinate construction and testing activities with testing agency as required.
- B. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 - 1. When average high and low temperature is expected to fall below 40 deg F (4.4 deg C) for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 - 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- C. Hot-Weather Placement: Comply with ACI 301 and as follows:
 - 1. Maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 - 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Subject to compliance with project requirements, manufacturers offering Products which may be incorporated in the Work include the following:
 - 1. Applied Concrete Technology, Incorporated, Grayslake, IL (800) 228-6694.
 - 2. The Euclid Chemical Company, Cleveland, OH (800) 321-7628.
 - 3. Fortifiber Corporation, Reno, NV (800) 773-4777.
 - 4. ChemREX Inc, Shakopee, MN (800) 433-9517.
 - 5. Master Builders Construction Products, Cleveland, OH (800) 227-3350.
 - 6. Sika Corporation, Lyndhurst, NJ (201) 933-8800, (800) 933-7452.
 - 7. WR Meadows, Hampshire, IL (800) 342-5976.

8. Reef Industries, Houston, TX (800) 231-2077.
 9. STEGO Industries LLC, San Juan Capistrano, CA (877) 464-7834.
 10. L&M Construction Chemicals, Inc., Omaha, NE (402) 453-6600.
 11. Curecrete Chemical Company, Inc., Springville, UT (801) 489-5663.
 12. Midwest Floor Care Inc., Lincoln, NE (402) 477-2701.
- B. Division 01 Section - Product Requirements: Product options and substitutions. Substitutions: Permitted.

2.02 CONCRETE MATERIALS

- A. Portland Cement: ASTM C150 - Type I, gray, unless otherwise approved.
1. Assume full responsibility for the quality and soundness of cement. Cement is to be of one type and from the same mill; it is to be of uniform color for all concrete with permanently exposed concrete finishes.
- B. Requirements for concrete to receive densifier / hardener (but not polished): Comply with the most stringent requirements specified herein, or in structural notes, including:
1. Limit fly ash and slag as a replacement for portland cement, as indicated for application.
 2. Limit use of curing compounds as indicated.
 3. Do not use incompatible admixtures.
- C. Requirements for concrete to receive polished finish: Refer to Division 03, Section "Polished Concrete Floor Finishing", and notes in Structural Drawings as applicable, for additional information and requirements for concrete to receive polished finish. The most stringent requirements shall apply, including but not limited to the following:
1. Air entrainment is not allowed in concrete to receive polished finish.
 2. Chemical admixtures, curing compounds, and other topical applications shall be used with concrete to receive polished ONLY IF they are chemically compatible with the polishing products and process and are specifically approved by the Architect and by the polishing system Manufacturer.
 - a. Concrete to be polished shall be only wet cured with potable water, unless otherwise approved by Architect.
 3. Protection Requirements; Refer to Division 3, Section "Polished Concrete Floor Finishing."
- D. Admixtures: The following admixtures are permitted when approved in writing prior to use or are required as specified herein and shall be used in strict accordance with the manufacturer's specifications or recommendations:
- E. Calcium chloride: Conform to ACI 301. The chloride ion level shall not exceed 0.3 percent.
- F. Air-entraining admixtures: ASTM C260 shall be used to achieve the specified air content in all permanently exposed exterior concrete. For steel trowel interior slab finish, do not use air entrainment admixtures and total air entrainment must not exceed 3%. For steel trowel exterior slab finish, comply with ACI 318 and ACI 302.
1. Euclid: AEA-92 or Air Mix 200.
- G. Water-reducing admixtures: Conform to ASTM C494, Type A, containing not more chloride ions than allowed in paragraph C., above.
1. Euclid: Eucon WR series or Eucon MR.
- H. Water-reducing/accelerating admixtures: Conform to ASTM C494, Type C or E having long-term test results showing non-rusting on metal deck and reinforcing steel.
1. Euclid: Accelguard series.
- I. Water-reducing/retarding admixtures: Conform to ASTM C494, Type D containing not more than 1 percent chloride ions.
1. Euclid: Eucon Retarder series.

- J. High-range/water-reducing (HRWR) admixtures: Conform to ASTM C494, Type F or G super plasticizers containing 1 percent maximum chloride ions may be used with low slump (3 inches maximum) concrete to produce flowable concrete (up to 8 inches slump) with early strength gain and 28-day strengths equal to reference concrete. HRWR admixture may be used providing not more than 60 minutes is allowed from addition of admixture to final placement of concrete. HRWR admixture shall be used in concrete with a maximum water/ cement ratio of 0.50 or less and is suggested in the following:
 - 1. In pumped concrete.
 - 2. In concrete topping slabs
 - 3. In lieu of the specified water-reducing admixture (Type A) where confinement of placing due to heavy reinforcement or narrow space requires flowable concrete.
 - 4. Where more than 30 minutes is required between the addition of admixtures to final placement of the concrete, a combination of water-reducing, set controlling admixtures (ASTM C494, Types A, D, & E) as in Master Builders Company "Synergized Performance System" may be used.
 - a. Euclid: Eucon 37 or Eucon 537.
- K. Fly ash or granulated blast furnace slag shall be used as a substitute for 25 percent of Portland cement, except where limited by other applications, including the following:
- L. Certification: Certification of the above requirements is required from the admixture manufacturer prior to mix design review and approval by the Architect. Upon request by the Architect, a qualified representative is to be provided to assure proper use of admixtures. Use of admixtures, other than listed above will be permitted only when approved.
- M. Aggregates:
 - 1. Normal-weight concrete - ASTM C33. For slabs, also conform to combined aggregate grading recommendations of ACI 302 and ACI 302.1R, unless otherwise permitted.
 - 2. All concrete exposed to the weather shall conform to the limits of deleterious substances and physical properties of Table 3, ASTM C 33.
 - 3. Local aggregates: Local aggregates not complying with ASTM C33 but which have been shown by special test or actual service to produce concrete of adequate strength and durability may be used when acceptable to the Architect.
 - 4. Maximum size of coarse aggregates: ACI 301.
 - 5. Abrasive aggregates non-slip finishes: Fused aluminum oxide grits, or crushed emery, as abrasive for non-slip finish with emery aggregate containing not less than 40 percent aluminum oxide and not less than 25 percent ferric oxide. Use material that is factory-graded, packaged, rustproof, non- glazing, and unaffected by freezing, moisture, and cleaning materials.
- N. Water: Clean and not detrimental to concrete; drinkable.

2.03 FINISHING MATERIALS

- A. Cement Floor Leveling Compound: Camp's "Latex Mix" (Liquid Felt up to 1/8" over 1/8" mix with Portland Cement and Sand), as distributed by the Tichenor Company, Dallas, Texas or approved equal. Floor leveling compound may only be used where floor will not be exposed.

2.04 GROUT / MORTARS

- A. Cement grout: Conform to ASTM C387 "Dry packaged mixtures" or:
 - 1. Mix at the site, in composition of one volume of Portland cement to 2-1/2 volumes of fine aggregate.
 - 2. Mix the materials dry; then add sufficient water to make the mixture flow under its own weight.
 - 3. Submittals: The following laboratory test results shall be submitted to show compliance with the requirements of this specification:

- a. Initial setting time: 8 hours maximum
- b. Vertical shrinkage: 0
- c. Compressive strength: 5000 psi 7 days
- d. Compressive strength: 7000 psi 28 days
- 4. Field service: When required by the Architect, provide a qualified concrete technician employed by the Grout Manufacturer to assist in the initial grouting operations.
 - a. Euclid: NS Grout or Hi Flow Grout or E3 Grout series.
 - b. Sika: Sika Grout #212.

2.05 CURING MATERIALS

- A. Method of curing shall be approved by the finish flooring applicator where finishes are indicated.
- B. Wet Cure Blanket: Waterproof covering, for curing exposed finish concrete floors, shall be non-staining, reinforced with fibers, and conforming to the requirements of the current edition of ASTM C171-03, ASTM C171-97a, and AASHTO M171-00, standard specifications for sheet material for curing concrete slabs. McTech Group, Inc.; "UltraCure NCF", Loganville, GA (866) 913-8363, or comparable product by another Manufacturer.
- C. Curing Compounds:
 - 1. For Slabs not scheduled for Chemical Hardener: Clear Bond as made by Guardian Chemical Co., Acri-Seal as made by Toch Bros., Dress and Seal as made by L & M Construction Chemicals, MasterKure as made by Sonneborn, or Res-X Cure by Burke Concrete Accessories.
 - 2. For Slabs to be Chemically Hardened: Do not use film-forming curing compounds. Where curing compound is required, a non-film-forming curing compound chemically compatible with the hardener may be used, if first approved by the chemical hardener Manufacturer. Dissipating liquid membrane-forming compounds for curing concrete; Conform to ASTM C309, Type 1. Curing compound shall be compatible with floor sealer or finish used. Low VOC. At polished concrete finishes, use of curing compounds is not allowed unless specifically approved by the Architect and polishing system Manufacturer.
 - a. Euclid: VOX Kurex DR series; waterborne products.
 - b. W.R. Meadows: 1100 series.
 - c. L&M Construction Chemicals: Cure R.
 - d. Division 01 Section - Product Requirements: Product options and substitutions. Substitutions: Permitted.
- D. Evaporation retarder: "MasterKure ER 50" by BASF or equal; spray applied liquid film for hot weather finishing.
 - 1. Do not use evaporation retarder at slabs to be densified, unless specifically approved for compatibility by the densifier manufacturer.
- E. Water: Potable.

2.06 SEALERS AND DENSIFIER / HARDENERS

- A. Exterior Sealers: applied to horizontal concrete surfaces permanently exposed to salts, deicer chemicals and moisture, including parking decks. The manufacturer shall provide a 5-year labor and materials Warranty on performance of the sealer. Sealer shall be compatible with the curing compound used.
 - 1. Euclid: Eucoguard or Diamond Clear or Super Diamond Clear.
 - 2. ChemREX: Hydrozo Clear 40.
 - 3. Substitutions: Permitted.
- B. Floor Sealing Compound: "Master Seal 330" by Master Builders, Cleveland, Ohio or approved equal.

- C. Concrete Densifier / Sealer for Interior Concrete: Coordinate requirements of hardener/densifier products with concrete mix designs and chemical admixtures and curing methods. These products are chemically reactive with the free lime in concrete and performance and appearance will be adversely affected by chemicals that react with lime or that impede the ability of the hardener/densifier to react. Do not use chemical admixtures or curing compounds unless specifically approved in writing.
 1. Exposed concrete floor slabs, not indicated for polished finish or with light broom finish: Two- or Multiple-Coat, spray-applied, hardener/densifier. Chemical reactive magnesium fluorosilicate formulation with chemical resistant properties to alkali, acids, oils and salts, and does not substantially change appearance of concrete surfaces. Provide one of the following or approved equal product by another Manufacturer:
 - a. BASF; "MasterKure HD 300 WB".
 - b. Euclid Chemical Co; "Surf-Hard".
 2. Exposed concrete floor slabs with smooth troweled finish: One coat flood-applied, hardener/densifier. Chemical reactive silicate / silicate formulation that enhances sheen level of troweled concrete and is designed to maintain or increase sheen level over time with normal wear. Provide one of the following or approved equal product by another Manufacturer:
 - a. CureCrete Chemical Company; "Ashford Formula", www.ashfordformula.com.
 - b. Dayton Superior; "Sure-Hard Densifier J17", www.daytonchemical.com.
 - c. Euclid Chemical Company; "Euco Diamond Hard", www.euclidchemical.com.
 - d. L&M Construction Chemicals; "Seal Hard", www.lmmc.com.
 3. Refer to Division 03 "Polished Concrete Floor Finishing" for floor polishing system.

2.07 JOINTS AND EMBEDDED ITEMS:

- A. Construction and Contraction Joints: Comply with ACI 301 and recommendations of ACI 302.1R. Sealant shall be two-part semi-rigid epoxy, and shall have minimum Shore A Hardness of 80 when measured with ASTM D2240. A product that complies with these requirements is "Euco 700", as manufactured by The Euclid Company, Cleveland, OH (800) 321-7628.
- B. Isolation Joints: Fillers shall consist of 1/8 inch width strips of neoprene, synthetic rubber, or approved substitute, extending the full depth of the slab. Sealant shall be two-part elastomeric type, polyurethane base.

2.08 MISCELLANEOUS MATERIALS

- A. Expansion Joint Material: Preformed expansion joint material conforming to ASTM D-1751.
- B. Drilled Anchor Bolts: Shall be "Titen HD" bolts as manufactured by Simpson Strong-Tie.; "Kwik HUS-EZ", by Hilti Fastening Systems; or approved equal.
- C. Rust Inhibitor: For field application to metal accessories shall be Hi-Build Epoxoline manufactured by the Tnemec Co., Inc., Kansas City, Missouri or approved equal.
- D. Epoxy for Patching: Shall be a two-component polymer modified cementitious system equal to Sikatop series as manufactured by Sika Chemical Corp., Lyndhurst, New Jersey or approved equal. Sikatop product selected shall be appropriate for intended repair and shall be approved by Architect.
- E. Accessories: AC315 Galvanized chairs, stools, spacers, etc. shall be by Superior Manufacturing Co., or equal.
- F. Waterstop: Preformed flexible PVC CRD-C-572-74. waterstop for embedding in concrete to prevent passage of fluids through joints. Factory-fabricate corners, intersections and directional changes. Acceptable manufacturers include:
 1. Sika Corporation
 2. W. R. Meadows
 3. Or approved equal.

2.09 VAPOR RETARDER

- A. Provide cover over prepared soil, below aggregate base material at slabs-on-ground and over void forms unless otherwise noted on the plans. Use only materials which are resistant to decay when coated in accordance with ASTM E154.
- B. Reference Section 07 26 00. Vapor Barrier Membrane.

2.10 PROPORTIONING

- A. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301. If laboratory trial batch method is used, use an independent testing facility acceptable to Architect for preparing and reporting proposed mix designs. The testing facility shall not be the same as used for field quality control testing and inspection unless otherwise acceptable to Architect.
- B. Submit written reports to the testing laboratory of each proposed mix for each class of concrete at least 15 days prior to start of work. Do not begin concrete production until mixes have been reviewed and approved. Include the following information for each concrete mix design:
 - 1. Method used to determine the proposed mix design.
 - 2. Gradation of fine and coarse aggregates, plus combined aggregate gradation for slabs, ACI 302.
 - 3. Proportions of all ingredients including all admixtures added either at the time of batching or at the job site.
 - 4. Water-cement ratio.
 - 5. Slump, ASTM C143.
 - 6. Certification of the chloride content of individual admixtures and of the mixes as proposed.
 - 7. Air Content: ASTM C173 (Volumetric Method).
 - 8. Unit weight of concrete, ASTM C138.
 - 9. Strength at 4, 7, and 28 days, ASTM C39.
 - 10. Method of recording batch proportions.
 - 11. Substantiating test reports.
- C. Concrete types and strengths: Minimum 28 Day Compressive Strength shall be per design requirements but not less than:
 - 1. Slabs on ground, walls, drilled piers: 3,000 psi.
 - 2. Slabs on void forms: 4,000 psi
 - 3. Normal or Lightweight concrete on metal deck: 3,000 psi.
 - 4. All concrete exposed to weather shall be air entrained (ASTM C260).
 - 5. All concrete shall be normal weight unless noted otherwise.
Also, see general and specific notes on structural drawings.
- D. Weights: All concrete shall be normal-weight concrete unless otherwise designated on the structural drawings.
- E. Durability: Conform to ACI 301.
 - 1. All concrete exposed to potentially destructive weathering, such as freezing and thawing, or to de-icer chemicals is to be air-entrained, 4.5% $\pm$ 1.5%, six sacks cement/cu. yd. min., 4" max. slump.
 - 2. Water-cement ratio: For concrete subject to freezing and thawing or deicer chemicals, the water-cement ratio shall not exceed 0.53 by weight including any water added to meet specified slump in accordance with the requirements of ASTM C94 unless otherwise noted.
- F. Slump: Conform to ACI 301.
 - 1. 4 1/2 inch maximum for consolidation by vibration
 - 2. 5 inch maximum for consolidation by other methods
 - 3. 8 inch maximum for flowable concrete. Concrete containing HRWR admixture (super plasticizer): 3 inch maximum before addition of HRWR

4. Where field conditions require slump to exceed that specified above, the increased slump shall be obtained by the use of a superplasticizer only, and the Contractor shall obtain written approval from the Architect who may require an adjustment to the mix.
- G. Production of concrete: Conform to ACI 301:
1. Ready-mixed concrete:
 - a. Ready-mixed concrete shall be batched, mixed, and transported in accordance with ASTM C94.
 - b. All concrete shall be proportioned conforming to the approved mix designs and of the materials contained in those approved mixes. A certified copy of the design weights for each mix shall be kept at the producing plant for each class of concrete used on the project.
 - c. Plant equipment and facilities are to conform to the "Check List for Certification of Ready -Mixed Concrete Production Facilities" of the National Ready-Mixed Concrete Association and have NRMCA or approved certification within the past year.
 2. All other concrete: Conform to ACI 301
 3. Concrete produced by on-site volumetric batching and continuous mixing if approved shall conform to ASTM C685.
 4. Use of accelerating admixtures in cold weather and retarding admixtures in hot weather shall not relax placement requirements specified herein.
 5. Admixtures: ACI 301. All concrete placed at ambient temperatures below 50°F is to contain an approved accelerator. All concrete placed at ambient temperatures above 80°F is to contain an approved retarder. All concrete required to be air-entrained is to contain an approved air-entraining admixture. When improved workability, pumpability, lower water-cement ratio, or high ultimate and/or early strength is required, the HRWR admixture (super plasticizer) may be used.
 6. Ensure air content for slabs with steel trowel finish is less than 3%. The concrete shall be of such consistency and composition that it can be worked readily into the corners and angles of the forms and around reinforcement without permitting materials to segregate or free water to collect on the surfaces. Within the limiting requirements, adjust the consistency of the concrete as may be necessary to produce mixtures which will be placeable with reasonable methods of placing and compacting. Maintain on the job at all times adequate extra cement to be used at rate of 1/2 sack cement per cubic yard concrete for each 2" slump increase for corrections due to wetness desired or obtained. No water shall be added to concrete except under the direct awareness of the project inspector.
 7. Adjustments to concrete mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant at no additional cost to Architect. Laboratory test data for revised mix design and strength results must be submitted and accepted before using in work.

2.11 FORMWORK

- A. Division 03 Section - Concrete Forms and Accessories

2.12 REINFORCING MATERIALS

- A. Division 03 Section - Concrete Reinforcement

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Division 01 Section - Execution Requirements: Verification of existing conditions before starting work.

- B. Verification of Conditions: Verify that field measurements, surfaces, substrates and conditions are as required, and ready to receive Work.
- C. Report in writing to Architect prevailing conditions that will adversely affect satisfactory execution of the Work of this Section. Do not proceed with Work until unsatisfactory conditions have been corrected.
- D. By beginning Work, Contractor accepts conditions and assumes responsibility for correcting unsuitable conditions encountered at no additional cost to the Owner.

3.02 INSTALLATION - GENERAL

- A. Install all cast-in-place concrete work in accordance with ACI 301 except as herein specified.

3.03 INSTALLATION - FORMWORK

- A. Division 03 Section - Concrete Forms and Accessories
- B. Construction and Contraction Joints: Conform to ACI 301 and recommendations of ACI 302.1R.

3.04 REINFORCEMENT

- A. Placement: Division 03 Section - Concrete Reinforcement

3.05 CONCRETE (CONVEYING AND DEPOSITING)

- A. Placement: Conform to ACI 301:
 1. Maintain concrete cover around reinforcing as specified herein and ACI 301.
 2. Pumping concrete: ACI 304.2-R.
 3. Cold-Weather Placement: Comply with provisions of ACI 306.1 "Standard Specifications for Cold-Weather Concreting" and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 4. When air temperature has fallen to or is expected to fall below 40 deg F (4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C) and not more than 80 deg F (27 deg C) at point of placement.
 - a. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 - b. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise accepted in mix designs.
 5. Hot-Weather Placement: When hot weather conditions exist that would impair quality and strength of concrete, place concrete complying with ACI 305R "Standard Specification for Hot-Weather Concreting" and as specified.
 - a. Cool ingredients before mixing to maintain concrete temperature at time of placement to below 90 deg F (32 deg C). Mixing water may be chilled or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 - b. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedding in concrete.
 - c. Fog spray forms, reinforcing steel, and subgrade just before placing concrete. Keep subgrade moisture uniform without puddles or dry areas.
 - d. Use water-reducing retarding admixture when required by high temperatures, low humidity, or other adverse placing conditions, as acceptable to Architect.
- B. Protection of cast concrete: Conform to ACI 301.
- C. Where the use of synthetic fibers is specified, fibers shall be added at a rate of 5.0 million fibers per cubic yard.

- D. Repair of surface defects: ACI 301.
 - 1. Inspect concrete surfaces immediately upon removal of forms. Patch imperfections as needed or as directed by the Architect.
 - 2. Modify or replace concrete not conforming to required thickness, lines, details, and elevations.
 - 3. Repair or replace concrete with excessive honeycombing and other defects due to improper placement. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Architect for each individual area.
 - 4. Tie holes shall be filled solid with patching mortar.

3.06 FINISHING

- A. Finishing of formed surfaces: ACI 301:
 - 1. Tops of forms:
 - a. Strike concrete smooth at tops of forms.
 - b. Float to texture comparable to formed surfaces.
 - 2. Formed surfaces:
 - a. Permanently exposed surfaces and surfaces to be painted: ACI 301 - "Smooth Form Finish" with the fins ground smooth and air holes or honeycomb filled with mortar.
 - b. Surfaces in unfinished areas unexposed to public view: ACI 301 - "Rough Form Finish".
- B. Slabs: Minimum slab surface tolerance must satisfy ACI 301 and ACI 302.1R as measured in accordance with ASTM E1155.
 - 1. Slabs-on- ground:
 - a. Preparation of sub-grade: Compact stone base aggregate to thickness indicated on drawings. Roll poof stone screenings topping to provide smooth hard surface on which to place slab. Surface should not show footprints or truck tracks when driven over.
 - b. Place floor slabs-on- ground by "strip cast" method. Contraction joints where shown on drawings shall be saw-cut (as soon as slab has set enough to allow working on but not before it has set enough to prevent raveling) 1/4 of the depth of slab thickness. It is recommended to use a SOFF-CUT saw and blades (between 1 to 4 hours after finish typically with 1 inch minimum depth) for all contraction joints as per manufacturer recommendations.
 - c. For exposed slabs, install semi-rigid epoxy sealant in construction and contraction joints after slab has fully dried.
 - d. Separate slabs-on- ground from vertical surfaces with 1/2 inch-thick joint filler. Extend joint filler from bottom of slab to within 1/8 inch of finished slab surface.
 - e. Allowable tolerance for slab on grade surfaces, measured in accordance with ACI 117 and ASTM E1155, shall meet or exceed an overall value of FF35/FL25, with minimum local value of FF24/FL17.
 - 2. Suspended Floor Slab:
 - a. Minimum surface tolerances: FF25 & FL20 overall FF20 & FL15 local.
- C. Float Finish:
 - 1. Locations: All concrete surfaces under mud-set tile or pavers.
 - 2. Finishing: After concrete has stiffened sufficiently and bleed water has evaporated, the surface shall be wood floated to produce a uniform texture with no coarse aggregate visible. Apply sufficient pressure to bring the moisture to the surface.
- D. Trowel Finish:
 - 1. Locations: All concrete surfaces under:
 - a. Thin set tile
 - b. Carpets
 - c. Vinyl floor tile
 - d. Exposed concrete

- e. Typical unless noted otherwise
- 2. Troweling: Steel trowel not less than two passes. Begin troweling with power trowel as soon as little or no cement sticks to the blades. Dusting with dry cement or aggregate to stiffen mix or absorb moisture is not allowed. The concrete shall then be hand troweled or machine troweled to produce a smooth impervious surface for the purpose of burnishing.
- E. Broom Finish:
 - 1. Locations: Exterior stairs, ramps, walks and other locations where noted on the drawings.
 - 2. Finishing: Same method as specified for trowel finish, except after initial troweling brush concrete surfaces with a soft brush or broom to texture as specified by the architect.
- F. Power Machine Finishing: In place of hand finishing, the Contractor may use a power machine approved by the Architect for finishing the concrete surfaces for finishing the concrete surfaces. However, the preparation of concrete surfaces for finishing by machine shall be, in general, as hereinbefore required for hand finishing.
- G. Non-slip Finish: Apply abrasive aggregate at the rate of 25 lbs. per 100 SF per manufacturer's instructions in areas specified.

3.07 CURING AND PROTECTION

- A. Protect all freshly placed concrete from washing by rain, flowing water, etc. Do not allow concrete to dry out from the time it is deposited in the forms until the expiration of the curing period hereinafter specified. The methods of curing shall be as specified in the following paragraphs, unless otherwise authorized by the Architects.
- B. Concrete surfaces, not otherwise specified, shall be cured by being kept wet with clean water for a period of not less than seven (7) days after placing. Each day the forms are left in place and kept wet enough to prevent the opening of joints in the forms and the drying out of the concrete, will be counted as one (1) day of curing.
- C. In lieu of the wetting specified above, the Contractor may, use a non-bituminous liquid sealing and curing compound to seal the moisture in the concrete. Such material shall not, however, be applied to surfaces which are to receive further concrete, mortar, resilient tile or liquid vinyl coating. Curing liquid, if used, shall be applied in conformity with the recommendations of the manufacturer of the material approved for use, and to sufficient extent to effectively hold the moisture in the concrete. The use of such material shall not relieve the Contractor of the responsibility of protecting all floor slabs, platforms, and steps whenever any scaffolding, shoring, form work, masonry, concrete or other work is being done over or above finished concrete slabs.
- D. Permanently exposed concrete floors shall be cured by covering the entire surface, as soon as practical after finishing, with waterproof paper, laid with four-inch (4") lapped joints. The joints shall be covered with gummed tape or be glued with waterproof glue. Such covering shall remain in place until completion of the building, except on surfaces where ceramic tile is to be applied, in which cases the covering shall be removed after a period of seven (7) days has elapsed after the placing and finishing of the concrete. Tears in paper shall be repaired.
- E. Imperfect or damaged work, or any material damaged or determined to be defective before final completion and acceptance of the entire job, shall be satisfactorily replaced at the Contractor's expense, and in conformity with all of the requirements of the Drawings and Specifications. Removal and replacement of concrete work shall be done in such manner as not to impair the appearance or strength of the structure in any way.

- F. Cleaning: Upon completion of the work, all forms, equipment, protective coverings and any rubbish resulting therefrom shall be removed from the premises. Finished concrete surfaces shall be left in a clean condition, satisfactory to the Owner. After sweeping with an ordinary broom and removing all mortar, concrete droppings, loose dirt, mud, etc., wash all concrete floors and platforms with soapsuds and scrub with a stiff fiber brush. Mop up the suds and flush the surfaces with clean water. Provide adequate measures during scrubbing, mopping, and flushing operations to keep excessive or injurious amounts of water off resilient tile floors. Any damage to such floors shall be promptly, effectively and satisfactorily repaired.

3.08 PATCHING AND REPAIR

- A. Comply with ACI 301 and ACI 503.2 for standard specifications for bonding plastic concrete to hardened concrete with a multiple component epoxy adhesive.
- B. Remove honeycomb voids, cracks, and irregularities. Where repair is required, cut back defects not less than 1/2" with square edges, brush out, drench with water and fill with concrete of same mix from which coarse aggregate is removed. When cut-outs have been filled, trowel surface smooth, remove excess grout and after set, grind slightly to uniform color and appearance using neat Portland Cement applied with a power grinder wheel.

3.09 GROUTING

- A. After steel columns have been installed and leveled, grout the space between the bottom of the plate and concrete, using cement grout completely filling the space and forming solid bearing for the column base plate.

3.10 EVALUATION AND ACCEPTANCE OF CONCRETE

- A. Comply with ACI 301.

3.11 ACCEPTANCE OF STRUCTURE

- A. Comply with ACI 301.

3.12 MISCELLANEOUS CONCRETE

- A. Curbs: Provide monolithic finish to interior surface of curbs by stripping forms while concrete is still green and steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- B. Equipment bases and foundations: Provide machine and equipment bases and foundations as shown on drawings. Set anchor bolts for machines and equipment with template at correct elevations, complying with certified diagrams or templates of manufacturer furnishing machines and equipment.

3.13 FIELD QUALITY CONTROL

- A. Materials and operations shall be tested and inspected as work progresses. Failure to detect defective work shall not prevent rejection when defect is discovered, nor shall it obligate the Architect for final acceptance.
- B. Testing agencies shall meet the requirements of "Recommended Practice for Inspection and Testing Agencies for Concrete and Steel in Construction" ASTM E 329.
- C. The following testing services shall be performed by the testing laboratory:
1. Secure concrete samples in accordance with "Method of Sampling Fresh Concrete" ASTM C172-.

2. Mold and cure four specimens from each sample in accordance with "Method of Making and Curing Concrete Compression and Flexural Specimens in the Field" ASTM C31-. The cylinders shall be stored in the field for 24 hours and then transported to the laboratory to be cured.
 3. Test specimens in accordance with "Method for Test for Compressive Strength of Molded Concrete Cylinders" ASTM C39-. Two specimens shall be tested at 28 days for acceptance and one shall be tested at 7 days for information. One specimen shall be held for future testing, if required.
 4. Make one strength test (four cylinders) for each 100 cu. yd. or fraction thereof, of each mix design of concrete placed in any one day.
 5. Determine total air content of air entrained normal weight concrete for each strength test in accordance with ACI 231.
 6. Report test results in writing to the Architect and Structural Engineer on the same day that tests are made. Reports of compressive strength tests shall contain the project identification name and number, date of concrete placement, name of contractor, name of concrete type and class, location of concrete batch in the structure, design compressive strength at 28 days, concrete mix proportions and materials; compressive breaking strength and type of break for both 7-day test and 28-day tests, air content.
 7. Determine slump for each strength test and whenever consistency of concrete appears to vary, using "Method of Test for Slump of Portland Cement Concrete" ASTM C143.
 8. Determine temperature of concrete sample for each strength test.
- D. Additional Tests: The testing service will make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained. Test to determine adequacy of concrete will be by cored cylinders complying with ASTM C42. Contractor shall pay for such test conducted, and any other additional testing as may be required, when unacceptable concrete is verified.
- E. Monitor the addition of water at the jobsite and the length of time concrete is allowed to remain in the truck before placement.
- F. Testing non-shrink grout: Make one strength test for every 10 baseplates grouted.
- G. The Contractor shall provide and pay for the necessary testing services of the following:
1. Qualification of proposed materials and the establishment of mix designs in accordance with "Building Code Requirements for Structural Concrete" ACI 318.
 2. Other testing services needed or required by the Contractor.
- H. To facilitate testing and inspection, the contractor shall:
1. Furnish necessary labor to assist testing agency in obtaining and handling samples at the job site.
 2. Advise the testing agency in advance of operations to allow for the assignment of testing personnel and testing.
 3. Provide and maintain for the use of the testing agency adequate facilities for proper curing of concrete test specimens on the project site in accordance with "Methods of Making and Curing Concrete Compression and Flexural Specimens in the Field" ASTM C31.
- I. Evaluation and acceptance:
1. The strength level of the concrete will be considered satisfactory if the averages of all sets of three consecutive strength test results equal or exceed specified strength and no individual test result (average of two cylinders) is below specified strength by more than 500 psi.
 2. Completed concrete work will be accepted when the requirements of "Specifications for Structural Concrete for Buildings" ACI 301, Chapter 18 have been complied with.

3. In any case, where the average strength of the laboratory control cylinders, as shown by the tests for any portion of the structure, falls below the minimum specified ultimate compressive strength, the Architect shall have the right to require the Contractor to provide improved curing conditions of temperature and moisture to secure the required strength. Also, if the average strength of the laboratory control cylinder should fall so low as to cause the portions of the structure to which the respective unsatisfactory test reports apply to be in question by the Architect, the Contractor shall follow the core procedure set forth in the current edition of ASTM C42. If the results of the core tests indicate, in the opinion of the Architects, that the strength of the structure is inadequate, such replacement, load testing, or strengthening as may be ordered by the Architects shall be provided by the Contractor without cost to the Owner.
- J. Reports: The testing laboratory shall make reports to the following:
- Concrete supplier - 1 copy
 - Contractor - 1 copy
 - Owner - 1 copy
 - Architect - 1 copy
 - Structural Engineer - 1 copy
1. Reports shall be made and distributed immediately after the respective tests or inspections are made.
 2. Where reports indicate deviations from the Contract Documents, they shall also include a determination of the probable cause of the deviation and where applicable, a recommendation for corrective action.
 3. Wherever the testing laboratory recognizes a trend of decreasing quality in the concrete due to changing reasons, conditions of curing or other cause; this shall be brought to the attention of the Architect, along with a recommendation for corrective action to be taken before the materials fall below the requirements of these Specifications.
- K. Authority & Responsibilities of the Testing Laboratory
1. The laboratory representative shall immediately notify the Architect and the Contractor of any deviance from Specifications and approved design mixes observed at the mixing plant or the job site.
 2. If, in the opinion of the laboratory representative, the deviance observed will be probable cause for subsequent rejection of the material, he shall so inform the Contractor and Architect so that a timely decision as to whether or not to continue operations can be made.
 3. Subsequent to on-the-spot verbal notification, the laboratory shall file a written report of any deficiencies or deviance noted including a summary of conversations and decisions made and action taken at the time in accordance with Paragraph 1.
 4. The testing laboratory shall control field adjustments made to concrete mixes to compensate for field conditions and report same in accordance with Paragraph H.

END OF SECTION 03 30 00

SECTION 03 35 00 - CONCRETE FINISHES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. General Coordination Procedures, (Reference Specification Section 01 31 00) General Contractor shall coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work that depend on each other for proper installation, connection, and operation.

1.02 SUMMARY

- A. Section Includes:
 - 1. Concrete finishes.
 - 2. Curing products.
 - 3. Concrete sealers and hardeners.
- B. Related Sections include the following:
 - 1. Division 03 Section - Cast-in-Place Concrete.
 - 2. Division 3 Section "Polished Concrete Floor Finishing".
 - 3. Division 7 Section "Joint Sealants".

1.03 REFERENCES

- A. The latest adopted edition of all standards referenced in this section shall apply, unless noted otherwise.
 - 1. ACI 301 - Specifications for Structural Concrete for Buildings
 - 2. ACI 302 - Guide for Concrete Floor and Slab Construction
 - 3. ASTM E1155 - Determining Floor Flatness and Levelness Using the F-Number System (Inch-Pound Units).

1.04 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.
- B. Product Data: Submit manufacturer's data showing compliance with the specifications.
- C. Mockups: Build concrete mockups to demonstrate typical joints, surface finish, texture, and standard of workmanship.
 - 1. Build finish mockups approximately as 8'x8'x4" temporary slabs for Owner's review and approval of apparatus bay finish texture.
 - 2. If Architect determines that mockups do not meet requirements, demolish and remove them from the site and cast others until mockups are approved.
 - 3. Refer to Division 03 Section "Polished Concrete Floor Finishing" for polished slab mockups.
- D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."
 - 1. The Contractor shall call a meeting to review the detailed requirements for floor construction, including the concrete placing techniques, finishing techniques, curing techniques, and the application of floor finishing materials. All contractors involved in the floor installation shall attend the conference.

2. Contractor shall verify that the planned concrete finish measurements and tolerances are acceptable for the flooring material and product specifications.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage, mixing with other components, and application.
- B. Store materials to comply with manufacturer's written instructions to prevent deterioration from moisture or other detrimental effects.

1.06 PROTECTION

- A. Protect exposed concrete finishes from damage and soiling by other trades. Mask surfaces with polyethylene film as required. Cover exposed concrete floors to receive sealed finish to protect against spillage of grease, paint, pitch, and other harmful substances. Alternate protection methods may be used if approved by Architect in writing.

PART 2 - PRODUCTS

2.01 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming; manufactured for application to fresh concrete.
 1. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
 2. Moisture-Retaining Cover: Waterproof paper, for curing exposed finish concrete floors, shall be non-staining, reinforced with fibers, and conforming to the requirements of the current edition of ASTM C171-03. A product that meets these requirements is "UltraCure NCF" as manufactured by McTech Group, Inc., Loganville, GA (866) 913-8363.
 3. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, 25 percent solids content, minimum.
 4. Water: Potable.

2.02 FLOOR AND SLAB SEALANT TREATMENTS

- A. Concrete Sealers, Hardeners and Coatings: Coordinate requirements of hardener/densifier products with concrete mix designs and chemical admixtures and curing methods. These products are chemically reactive with the free lime in concrete and performance and appearance will be adversely affected by chemicals that react with lime or that impede the ability of the hardener/densifier to react. Do not use chemical admixtures or curing compounds unless specifically approved in writing.
 1. Exposed concrete floor slabs with light broom finish: Two- or Multiple-Coat, spray-applied, hardener/densifier. Chemical reactive magnesium fluorosilicate formulation with chemical resistant properties to alkali, acids, oils and salts, and does not substantially change appearance of concrete surfaces. Provide one of the following or approved equal product by another Manufacturer:
 - a. MasterKure HD 300 WB by BASF.
 - b. "Surf-Hard" by Euclid Chemical Co.
 2. Exposed concrete floor slabs with smooth troweled finish: One coat flood-applied, hardener/densifier. Chemical reactive silicate / siliconate formulation that enhances sheen level of troweled concrete and is designed to maintain or increase sheen level over time with normal wear. Provide one of the following or other comparable product by another Manufacturer:

- a. Dayton Superior; "Sure-Hard Densifier J17", www.daytonchemical.com.
- b. CureCrete Chemical Company; "Ashford Formula", www.ashfordformula.com.
- c. Euclid Chemical Company; "Euco Diamond Hard", www.euclidchemical.com.

2.03 RELATED MATERIALS

- A. Semi-rigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A Shore durometer hardness of 80 per ASTM D 2240.
- B. Sawcut joint filler: Euco 700 epoxy by The Euclid Chemical Company, or approved equal.
- C. Refer to Division 03 Section "Cast in Place Concrete", for patching materials and other materials related to non-polished concrete.
- D. Refer to Division 03 Section "Polished Concrete Floor Finishing" for materials related to polished floors.
- E. Sealants: Refer to Division 07 "Joint Sealants".

PART 3 - EXECUTION

3.01 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
 - 1. Concrete slabs shall be finished as specified below, within the tolerances specified elsewhere in this Section.
 - 2. Highway straightedges are recommended for use in lieu of bullfloats for all slab placement and finishing operations.
 - 3. Screeding: Immediately after placing, slab shall be vibrated and struck off true by double screeding to the required level, at or below the elevation or grade of the finished slabs as indicated on the Drawings.
 - 4. Vibrators shall not be used to spread the concrete. When camber is indicated for slabs supported on formwork, screed to the required camber. Fixed screed guides are recommended where specified surface tolerance exceeds FF25/FL20.
 - 5. Takes care when using vibrators at polished floor slabs to ensure vibrator is not in contact with reinforcing which could cause "ghosting" of the reinforcing in the polished slab finishes. Coordinate requirements with the polished floor finish applicator.
 - 6. Floating: Immediately after screeding, before any excess bleed water is present on the surface, float the surface using long-handled bull floats or darbies.
 - 7. Straightedging: Immediately after screeding and before excess bleed water is present on the surface, straighten the surface using a highway straightedge.
 - 8. Edging and jointing, where required, shall be done after bleed water has evaporated and before further finishing.
- B. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture.
 - 1. Apply float finish to surfaces to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.
 - 2. Locations: All concrete surfaces under waterproofing membrane, setting beds for brick, mud-set tile, pavers, or terrazzo, and noncomposite topping slabs.
- C. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
 2. Locations: Exposed concrete floors not otherwise specified, concrete surfaces under carpets, vinyl tile, thin set tile, wood flooring, elastomeric coatings, and painted concrete floors.
- D. Trowel and Fine-Broom or Horsehair Finishes: Apply a first trowel finish to surfaces where ceramic tile is to be installed by either thickset or medium / thin-set methods. While concrete is still plastic, slightly scarify surface with a fine broom.
1. Comply with flatness and levelness tolerances for trowel finished floor surfaces.
 2. Apply Horsehair or fine broom finish to apparatus bay floor, as approved by mockup review.
- E. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.
1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

3.02 FINISHING EXPOSED CONCRETE SURFACES

- A. General: Provide aesthetically pleasing concrete finish as judged by Architect for the following applications, and as herein specified:
1. Concrete plinth bollards, light or flag pole bases and similar conditions.
 2. Exposed interior concrete grade beams or elevation changes, mezzanine slab edges and similar conditions.
 3. Areas of exposed exterior grade beams or slab edges at building perimeter and/or dumpster enclosure.
- B. Preparations: As soon as forms are removed, remove undesired fins and other projections, level offsets, and saturate voids or damaged places immediately with water and repair with mortar of same composition as used in mix. Apply applicable finish as specified below, where scheduled and shown on Drawings.
- C. Concrete Plinth (Bollards): Plinths shall be finished to match lines and levels of other plinths, and shall be constructed with smooth, straight lines and consistent dimension chamfers throughout the work.
1. Variation in dimension of chamfers: 1/8" maximum.
 2. Other variations in dimensions and straightness of lines should not be noticeable when viewed with the unaided eye from a distance of 10 feet.
 3. Differences in finish between different plinths, or within a single plinth not noticeable when viewed from 10 feet away.
- D. Smooth Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform texture. Do not apply cement grout other than that created by the rubbing process. Continue surface treatment of adjacent similar formed surfaces until finish is uniform, unless otherwise indicated.
1. Exposed surfaces of concrete grade beams.
 2. Concrete plinths.
 3. Turn-down (retaining) edges of paving.
- E. Parged Finish: Provide at vertical surfaces exposed to view in completed work as specified herein and any other locations as indicated in Drawings.
1. After removal of forms, patching, and repairing, and while concrete is still green, spread slurry consisting of 1 part Portland cement and 1-1/2 part damp, loose sand by volume,

over pre-dampened surface. Apply using burlap pads or sponge rubber floats. Remove surplus material, and then rub with clean burlap. Finished rubbed surface shall be uniformly smooth, entirely free of pits, holes, or form marks and similar in texture to sand finished limestone. Large surface swirls or heavily textured surfaces are not acceptable. Finish shall match approved samples.

2. Locations: Interior mezzanine slab edges, and light pole bases. Protect masonry below, floor, and other adjacent finishes, from soiling when paring interior concrete.
- F. Wall Panel Finish: Apply medium sandblast to all exterior exposed surfaces of concrete wall panels; interior surfaces of panels to receive steel trowel finish and paint.
- G. Paint the following surfaces in color(s) as selected by architect to match or complement adjacent surfaces:
1. Concrete plinths.
 2. Light pole bases.
 3. Interior exposed concrete mezzanine slab edges and similar exposed interior concrete surfaces.
 4. Exposed grade beams, if directed by Architect.

3.03 LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions.
1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
 2. Do not apply to concrete that is less than 14 days' old. Do not apply in areas adjacent to those scheduled to receive polished concrete floor finish until there are solid walls and protection in place between these areas or until after polished concrete floor finishing is complete. Protect finished polished floors from contamination by the application of this product, inadvertent or otherwise.
 3. Apply spray application product (apparatus bay / light textured spaces) in two or more coats, in accordance with Manufacturer's application instructions.
 4. Apply flood application product (smooth troweled finished floor surfaces) until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner in accordance with Manufacturer's installation instructions if surface is still rough or porous.

3.04 SUBFLOOR MAINTENANCE AND PREPARATION

- A. Prior to installation of finish floor coverings, remove dirt, oil, grease, paint and other foreign matter from surfaces. Inspect for holes, cracks and other abrasions and fill such defects with latex floor leveling compound. Disc-sand high spots and abrasions.

3.05 CONTROL JOINTS

- A. Saw-cut Control Joints: Form weakened-plane control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut joints into concrete slab when cutting action will not tear, abrade, or otherwise damage surface and before random contraction cracks develop.
- B. Construct control joints for a combined depth equal to topping thickness and not less than one-fourth of base-slab thickness, unless otherwise indicated.

3.06 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.

- B. Defer joint filling until concrete has aged at least one month. Do not fill joints until construction traffic has permanently ceased.
- C. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.
- D. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.
 - 1. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

3.07 CONCRETE FINISH MEASUREMENT AND TOLERANCES

- A. Two-Tiered Measurement Standard: Each floor test section and the overall floor area shall conform to the two-tiered measurement standard as specified herein.
 - 1. Minimum Local Value: The minimum local FF/FL values represent the absolute minimum surface profile that will be acceptable for any one test sample (line of measurements) anywhere within the test area.
 - 2. Specified Overall Value: The specified overall FF/FL values represent the minimum values acceptable for individual floor sections as well as the floor as a whole.
- B. Floor Test Sections:
 - 1. A floor test section is defined as the smaller of the following areas:
 - a. The area bounded by column and/or wall lines.
 - b. The area bounded by construction and/or control joint lines.
 - c. Any combination of column lines and/or control joint lines.
 - 2. Test sample measurement lines within each test section shall be multidirectional along two orthogonal lines, as defined by ASTM E1155, at a spacing to be determined by the Owner's testing agency.
 - 3. The precise layout of each test section shall be determined by the Owner's testing agency.
- C. Concrete Floor Finish Tolerances:
 - 1. The following values apply before removal of shores. Levelness values (FL) do not apply to intentionally sloped or cambered areas, nor to slabs poured on metal deck or precast concrete.
 - a. Suspended/Structured Slabs:
 - 1) Floors to be covered with carpet or vinyl tile, unless otherwise specified:
 - a) Overall Value FF25/FL20
 - b) Minimum Local Value FF17/FL15
 - 2) Interior vehicle exposed concrete floors:
 - a) Overall Value FF20/FL15
 - b) Minimum Local Value FF15/FL10
 - 3) Floors to be covered with thin-set tile:
 - a) Overall Value FF35/FL20
 - b) Minimum Local Value FF24/FL15
 - 4) Mechanical rooms, recessed floors, and mezzanine slabs:
 - a) Overall Value FF20/FL15
 - b) Minimum Local Value FF15/FL10
 - 5) Exposed polished concrete floors: Refer to Division 03, Section "Polished Concrete Floor Finishing".
- D. Floor Elevation Tolerance Envelope:
 - 1. The acceptable tolerance envelope for absolute elevation of any point on the slab surface, with respect to the elevation shown on the Drawings, is as follows:
 - 2. Slab-on-Grade Construction: +/- 3/4"- Typ. U.N.O.

3. Top surfaces of formed slabs measured prior to removal of supporting shores: +/- 3/4"
4. Top surfaces of all other slabs: +/- 3/4"
5. Slabs specified to slope shall have a tolerance from the specified slope of 3/8" in 10'- 0" at any point, up to 3/4" from theoretical elevation at any point.

3.08 FIELD QUALITY CONTROL

A. Concrete Floor Flatness and Levelness:

1. Measurement Standard: Floors shall be measured for flatness and levelness according to ASTM E1155, "Standard Test Method for Determining Floor Flatness and Levelness Using the F-Number System." Tolerances are specified in Section 03 30 00.
2. Time Period for Measuring and Reporting: All measurements shall be made by the testing laboratory or designated agency before the end of the next workday after the completion of finishing operations. For structural elevated floors, measurement shall also be made prior to removal of forms and shores. The Contractor shall be notified immediately after the measurements of any section are complete, and a written report of the floor measurement results shall be submitted within 72 hours after finishing operations are complete. The Contractor shall take immediate action to correct any work that is outside the specified tolerances.
3. Measuring Equipment: The concrete surface profile shall be measured using equipment manufactured for the purpose, such as the Dipstick Floor Profiler, as manufactured by the Edward W. Face Company, Norfolk, Virginia, or by other methods specified in ASTM E1155.
4. Floor Test Sections:
 - a. A floor test section is defined as the smaller of the following areas:
 - b. The area bounded by column and/or wall lines.
 - c. The area bounded by construction and/or control joint lines.
 - d. Any combination of column lines and/or control joint lines.
 - 1) Test sample measurement lines within each test section shall be multidirectional along two orthogonal lines.
 - e. The precise layout of each test section shall be determined by the testing agency and shall be submitted for the Architect's review and approval.

3.09 REPAIRS

- A. Defective Topping: Repair and patch defective concrete floor topping areas, including areas that have not bonded to concrete substrate.
- B. Remedial Measures for Slab Finish Construction not Meeting Specified Tolerances:
 1. Application of Remedial Measures. Remedial measures specified herein are required whenever either or both of the following occur:
 - a. The composite overall values of flatness or levelness of any test section or the entire floor installation measure less than specified values.
 - b. Any individual test sample (line of measurements) measures less than the specified absolute minimum flatness or levelness value.
 2. Modification of Existing Surface:
 - a. If, in the opinion of the Architect or Owner's representative, all or any portion of the substandard work can be repaired without sacrifice to the appearance or serviceability of the area, the Contractor shall immediately undertake the approved repair method.
 - b. The Contractor shall submit for review and approval a detailed work plan of the proposed repair showing areas to be repaired, method of repair, and time required to make the repair.

- c. Repair method(s), at the sole discretion of the Architect or Owner's Representative, may include grinding (floor stoning), planing, re-topping with specified floor leveling compound, or any combination of the above.
 - d. All repair work shall be performed at no additional cost to the Owner and with no extension to the construction schedule.
- 3. Removal and Replacement:
 - a. If, in the opinion of the Architect/Engineer or Owner's Representative, all or any portion of the substandard work cannot be satisfactorily repaired without sacrifice to the appearance or serviceability of the area, the Contractor shall remove and replace the defective work as directed.
 - b. Replacement sections may be retested for compliance at the discretion of the Architect/Engineer or Owner's Representative.
- C. All replacement work shall be performed at no additional cost to the Owner and with no extension to the construction schedule.

3.10 CLEANING

- A. Clean surfaces as required with soap and water until foreign matter and dirt are removed.

END OF SECTION 03 35 00

SECTION 04 20 00 - UNIT MASONRY ASSEMBLIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. General Coordination Procedures, (Reference Specification Section 01 31 00) General Contractor shall coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work that depend on each other for proper installation, connection, and operation.

1.02 SUMMARY

- A. This Section includes unit masonry assemblies consisting of the following:
 - 1. Concrete masonry units (CMU's).
 - 2. Mortar and grout.
 - 3. Reinforcing steel.
 - 4. Masonry joint reinforcement.
 - 5. Ties and anchors.
 - 6. Embedded flashing.
 - 7. Miscellaneous masonry accessories.
 - 8. Masonry-cell insulation.
- B. Related Sections include the following:
 - 1. Division 07 Section - Fluid Applied Membrane Air Barriers for membranes applied to exterior face of gypsum sheathing at exterior masonry cavity walls.
 - 2. Division 07 Section - Bituminous Dampproofing for dampproofing applied to cavity face of backup wythes of cavity walls.
 - 3. Division 07 Section - Flashing and Sheet Metal for exposed sheet metal flashing.
 - 4. Division 07 Section - Firestopping for firestopping at openings in masonry walls.
 - 5. Division 07 Section - Joint Sealants for sealing control and expansion joints in unit masonry.
 - 6. Division 07 Section - Building Insulation for cavity wall insulation.
- C. Products furnished, but not installed, under this Section include the following:
 - 1. Dovetail slots for masonry anchors, installed under Division 03 Section - Cast-in-Place Concrete.
 - 2. Anchor sections of adjustable masonry anchors for connecting to structural frame, installed under Division 05 Section - Structural Steel.
- D. Products installed, but not furnished, under this Section include the following:
 - 1. Steel lintels and shelf angles for unit masonry, furnished under Division 05 Section - Metal Fabrications.
 - 2. Manufactured reglets in masonry joints for metal flashing, furnished under Division 07 Section - Sheet Metal Flashing and Trim.

1.03 DEFINITIONS

- A. Reinforced Masonry: Masonry containing horizontal reinforcing and vertical steel reinforcing in grouted cells.

1.04 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For the following:
 - 1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
 - 2. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement." Show elevations of reinforced walls.
 - 3. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.
- C. Samples for Verification: For each type and color of the following:
 - 1. Concrete Masonry Units: full size soap or block sample for each color and finish other than standard CMU.
 - 2. Pigmented and colored-aggregate mortar. Make Samples using same sand and mortar ingredients to be used on Project. Label Samples to indicate types and amounts of pigments used.
 - 3. Weep holes/vents.
 - 4. Accessories embedded in masonry.
- D. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.
 - 1. Submittal is for information only. Neither receipt of list nor approval of mockup constitutes approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Architect and approved in writing.
- E. Qualification Data: For testing agency.
- F. Installer Qualifications: Submit evidence of contractor state license and personnel training and experience in constructing masonry structures of similar nature to this project, with a minimum of 5 years of on the job successful construction experience. List project superintendent for masonry work's, experience, training and certifications.
- G. Material Certificates: Include statements of material properties indicating compliance with requirements including compliance with standards and type designations within standards. Provide for each type and size of the following:
 - 1. Masonry units.
 - a. Include material test reports substantiating compliance with requirements.
 - b. For bricks, include size-variation data verifying that actual range of sizes falls within specified tolerances.
 - c. For exposed brick, include material test report for efflorescence according to ASTM C 67.
 - d. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.
 - 2. Cementitious materials. Include brand, type, and name of manufacturer.
 - 3. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
 - 4. Grout mixes. Include description of type and proportions of ingredients.
 - 5. Reinforcing bars.
 - 6. Joint reinforcement.
 - 7. Anchors, ties, and metal accessories.
- H. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
 - 1. Include test reports, per ASTM C 780, for mortar mixes required to comply with property specification.

2. Include test reports, per ASTM C 1019, for grout mixes required to comply with compressive strength requirement.
- I. Cold-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with cold-weather requirements.

1.05 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1093 for testing indicated, as documented according to ASTM E 548.
- B. Applicator's Qualifications:
 1. Supervision: Maintain competent supervisor who is at Project during times specified Work is in progress, and, who is experienced in installing systems similar to type and scope required for Project.
 2. Experience: Company with not less than 5 years continuous experience under the current name in performing specified work similar in design, products, and extent to scope of this Project; with a record of successful in-service performance; and with sufficient production capability, facilities, and personnel to produce required Work.
 3. Upon request, submit list of a minimum of 5 completed projects of comparable or greater size and complexity to this Work. Include for each project:
 - a. Project name and location.
 - b. Name and contact information for Owner.
 - c. Name and contact information of General Contractor (if applicable).
 - d. Name and contact information of Architect.
 - e. Name of Polished Concrete Floor Finish manufacturer.
 - f. Approximate square footage of densified diamond polishing system installed.
 - g. Date of completion.
- C. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, through one source from a single manufacturer for each product required.
- D. Fabrication of Acoustical Concrete Masonry Units: Carefully controlled use of the molds shall be employed so all units have one end of the cavities tightly closed. Slots and edges shall be straight and clean. Where units with metal inserts or fibrous or laminated fillers are called for, filler elements as supplied by the The Proudfoot Company shall be installed in the cavities of the blocks at the block plant. The filler shall be of specially fabricated incombustible fibrous material, cut accurately to size and installed as recommended. The fillers shall have metal septa laminated to one side of the fibrous material and shall be installed with the septa facing away from the slots. Where units with bare metal septa are called for, the bare (without fibrous material) metal septa shall be fabricated of 28 gauge, galvanized steel, furnished by the Proudfoot Company and installed in each cavity in the recommended manner at the block plant.
- E. Source Limitations for Mortar Materials: Obtain mortar ingredients for each type exposed unpainted masonry of a uniform quality, including color, from a single manufacturer for each cementitious component and from one source or producer for each aggregate.
- F. Preconstruction Testing Service: Owner will engage a qualified independent testing agency to perform preconstruction testing indicated below. Payment for these services will be made by Owner. Retesting of materials that fail to meet specified requirements shall be done at Contractor's expense.
 1. Prism Test: For each type of construction required, per ASTM C 1314.
- G. Sample Panels: Build up to three sample panels to verify selections made under sample submittals and to demonstrate aesthetic effects. Comply with requirements in Division 01 Section - Quality Requirements for mockups.

1. Build sample panels for each type of exposed unit masonry construction at in sizes approximately 84 inches by 60 inches high by full thickness.
 2. Protect approved sample panels from the elements with weather-resistant membrane.
 3. Approval of sample panels is for color, texture, mortar wash and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; aesthetic qualities of workmanship; and other material and construction qualities specifically approved by Architect in writing.
 - a. Approval of sample panels does not constitute approval of deviations from the Contract Documents contained in sample panels unless such deviations are specifically approved by Architect in writing.
- H. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section - Project Management and Coordination.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- D. Deliver preblended, dry mortar mix in moisture-resistant containers designed for lifting and emptying into dispensing silo. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in a metal dispensing silo with weatherproof cover.
- E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.07 PROJECT CONDITIONS

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

- D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
 - 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and above and will remain so until masonry has dried, but not less than 7 days after completing cleaning.
- E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

PART 2 - PRODUCTS

2.01 MASONRY UNITS, GENERAL

- A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to exceed tolerances and to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects, including dimensions that vary from specified dimensions by more than stated tolerances, will be exposed in the completed Work or will impair the quality of completed masonry.
- B. Fire-Resistance Ratings: Where indicated, provide units that comply with requirements for fire-resistance ratings indicated as determined by testing according to ASTM E 119, by equivalent masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

2.02 CONCRETE MASONRY UNITS (CMU'S)

- A. Shapes: Provide shapes indicated and as follows:
 - 1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, partial height wall caps, bonding, and other special conditions.
 - 2. Provide custom shapes for all outside corners that are not 90 degrees.
 - 3. Provide bullnose units at all exposed interior outside corners, including corners of door and window openings, of finished CMU walls
 - a. Bullnoses may be site-tooled for standard and burnished block provided mockups for site tooling and finishing are approved by Architect.
 - b. Provide square-edged units for other outside corners, unless otherwise indicated.
- B. Concrete Masonry Units: ASTM C 90.
 - 1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 1900 psi.
 - 2. Weight Classification: Normal weight, unless otherwise indicated.
 - 3. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.
 - 4. Exposed Faces: Provide color and texture matching the range represented by Architect's sample.

2.03 MASONRY LINTELS

- A. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam concrete masonry units with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

2.04 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement with pigments as required to produce mortar color indicated:

1. As selected by Architect from full range of available colors
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C 979. Use only pigments with a record of satisfactory performance in masonry mortar.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Davis Colors; True Tone Mortar Colors.
 - b. Lanxess Corporation; Bayferrox Iron Oxide Pigments.
 - c. Solomon Colors, Inc.; SGS Mortar Colors.
- D. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMUs only, containing integral water repellent by same manufacturer.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ACM Chemistries, Inc.; RainBloc for Mortar.
 - b. BASF; MasterPel 240 Mortar Admixture.
 - c. Grace Construction Products, W. R. Grace & Co. - Conn.; Dry-Block Mortar Admixture.
- E. Workability Additive (Face Brick only): "A" Marble Dust by Armco Steel Corp., 90/200 Mineral Filler by Limestone Products.
- F. Aggregate for Mortar: ASTM C 144.
 1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
 2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.
- G. Aggregate for Grout: ASTM C 404.
- H. Tuck Pointing Grout for Resin Faced block (Astra-Glaze): Epoxy Mortar and Grout Mix, meeting ANSI 118.3, and resistant to swimming pool water chemicals: Pro-Spec Bonsal B-7000, mixed with BONSAL Polymer Modified Sanded Tile Grout, and with thickener additive as recommended by grout Manufacturer; or equal as acceptable to glazed CMU block Manufacturer and approved by Architect.

2.05 REINFORCEMENT

- A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60.
- B. Masonry Joint Reinforcement, General: ASTM A 951/A 951M.
 1. Interior Walls: Hot-dip galvanized, carbon steel.
 2. Exterior Walls: Stainless Steel Type 304.
 3. Wire Size for Side Rods: 0.187-inch diameter.
 4. Wire Size for Cross Rods: 0.148-inch diameter.
 5. Wire Size for Veneer Ties: 0.187-inch diameter.
 6. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
 7. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units.
- C. Masonry Joint Reinforcement for Single-Wythe Masonry: Either ladder or truss type with single pair of side rods, unless otherwise noted in Structural Drawings or Specifications.
- D. Masonry Joint Reinforcement for Multiwythe Masonry:
 1. Adjustable (two-piece) type, either ladder or truss design, with one side rod at each face shell of backing wythe unless otherwise noted in Structural Drawings or specifications, and with separate adjustable ties with pintle-and-eye connections having a maximum adjustment of 1-1/4 inches. Size ties to extend at least halfway through facing wythe but with at least 5/8-inch cover on outside face.

2. Available products:
 - a. Dur-O-Wall; Truss design DA3700 Dur-O-Eye.
 - b. Wire-Bond; Series 900 Level Hook and Eye Truss.
- E. Use reinforcing ladders one size smaller than nominal block size, or as directed by Manufacturer, at helmholtz resonator acoustical blocks.

2.06 TIES AND ANCHORS

- A. Materials: Provide ties and anchors specified in subsequent paragraphs that are made from materials that comply with subparagraphs below, unless otherwise indicated.
 1. Stainless Steel, Type 304, ASTM A580/ASTM 580M.
- B. Wire Ties, General: Unless otherwise indicated, size wire ties to extend at least halfway through veneer but with at least 5/8-inch cover on outside face. Outer ends of wires are bent 90 degrees and extend 2 inches parallel to face of veneer.
- C. Adjustable Anchors for Connecting to Structure: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
 1. Connector Section for Concrete: Dovetail tabs for inserting into dovetail slots in concrete and attached to tie section; formed from 0.053-inch- thick, steel sheet, galvanized after fabrication.
- D. Adjustable Masonry-Veneer Anchors at metal studs
 1. General: Provide anchors that allow vertical adjustment but resist tension and compression forces perpendicular to plane of wall, for attachment over sheathing to wood or metal studs, and as follows:
 - a. Structural Performance Characteristics: Capable of withstanding a 100-lbf load in both tension and compression without deforming or developing play in excess of 0.05 inch.
 2. Screw-Attached, Masonry-Veneer Anchors: Units consisting of a wire tie and a metal anchor section.
 - a. Anchor Section: Rib-stiffened, sheet metal plate with screw holes top and bottom, and having slotted holes for inserting vertical legs of wire tie specially formed to fit anchor section.
 - b. Fabricate sheet metal anchor sections and other sheet metal parts from 0.067-inch-thick, Stainless Steel, Type 304, ASTM A580/ASTM 580M.
 - c. Wire Ties: Triangular-, rectangular-, or T-shaped wire ties fabricated from 0.188-inch-diameter, Stainless Steel, Type 304, ASTM A580/ASTM 580M.
 - d. Available Products: Basis of Design Product[s] are:
 - 1) For Coursed Masonry: Hohmann & Barnard, Inc.; HB-200-X
 - a) Provide with membrane flashing tape at air barrier, provided and installed under Division 07 "Air Barrier" Section(s), or : Hohmann & Barnard, Inc. X-Seal Tape may be substituted if allowed by air barrier manufacturer.
 3. Stainless-Steel Drill Screws for Steel Studs: Proprietary fastener consisting of carbon-steel drill point and 300 Series stainless-steel shank, complying with ASTM C 954 except manufactured with hex washer head and neoprene washer, No. 10 diameter by length required to penetrate steel stud flange with not less than three exposed threads.
 - a. Available Products:
 - 1) Dayton Superior Corporation, Dur-O-Wal Division; Stainless Steel SX Fastener.
 - 2) ITW Buildex; Scots long life Tek.

2.07 EMBEDDED FLASHING MATERIALS

- A. Flexible Flashing (Copper Composite): For flashing not exposed to the exterior, use the following, unless otherwise indicated:

1. Copper-Laminated Flashing: ASTM B370, CDA Alloy 110, 3-oz./sq. ft. copper core laminated polymer fabric on both sides with non-asphaltic adhesive. Extend flashing past face of brick and trim flush after inspection.
 - a. Product:
 - 1) York Manufacturing, Inc.; York Copper Fabric Flashing, "Multi-Flash 500".
 - 2) STS Coatings, Inc.; Wall Guardian Copper TWF
 - 3) Wire-Bond, Inc.; Copper Seal
 2. Copper Laminated Flashing shall not be used for any flashings that will be exposed to view in the completed work. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for material type(s) for embedded flashings that are exposed to view or partially exposed to view. General Contractor shall coordinate responsibility to provide and install other flashing types.
- B. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.
1. One part 100% solids, solvent-free formulated silyl-terminated polyether (STPE), ASTM C920-11, Type S, Grade NS, Class 50, York "Universeal US100" or equivalent.
- C. Termination bars: Provide stainless steel termination bars in cavity walls where copper flashing will be installed with termination bars to concrete block backup and with asphaltic felts stripped in to protect top side of terminations (refer to Division 07 "Bituminous Dampproofing").
1. Do not use termination bars at face of sheathing unless specifically detailed otherwise in the Drawings. Through-wall flashings at stud construction shall extend through and turn up behind exterior sheathing, and air barrier system materials (per Division 07 "Air Barrier" Sections) shall lap over and down the face of these through-wall flashings.

2.08 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene.
- B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
- C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).
- D. Weep/Vent Products:
1. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch less than depth of outer wythe, in color selected from manufacturer's standard.
 - a. Available Products:
 - 1) Advanced Building Products Inc.; Mortar Maze weep vent.
 - 2) Dayton Superior Corporation, Dur-O-Wal Division; Cell Vents.
 - 3) Heckmann Building Products Inc.; No. 85 Cell Vent.
 - 4) Hohmann & Barnard, Inc.; Quadro-Vent.
 - 5) Wire-Bond; Cell Vent.
- E. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.
1. Provide one of the following configurations:

- a. Strips, full-depth of cavity and 10 inches wide, with dovetail shaped notches 7 inches deep that prevent mesh from being clogged with mortar droppings.
 - b. Strips, not less than 1-1/2 inches thick and 10 inches wide, with dimpled surface designed to catch mortar droppings and prevent weep holes from being clogged with mortar.
- 2. Available Products:
 - a. Advanced Building Products Inc.; Mortar Break II.
 - b. Dayton Superior Corporation, Dur-O-Wal Division; Polytite MortarStop.
 - c. Mortar Net USA, Ltd.; Mortar Net.
- F. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells with loops for holding reinforcing bars in center of cells. Units are formed from 0.142-inch steel wire, hot-dip galvanized after fabrication. Provide units with either two loops or four loops as needed for number of bars indicated.
 - 1. Available Products:
 - a. Dayton Superior Corporation, Dur-O-Wal Division; D/A 810, D/A 812 or D/A 817.
 - b. Heckmann Building Products Inc.; No. 376 Rebar Positioner.
 - c. Hohmann & Barnard, Inc.; #RB or #RB-Twin Rebar Positioner.
 - d. Wire-Bond; O-Ring or Double O-Ring Rebar Positioner.
 - 2. In event of conflict with reinforcing bar positions required in Structural Drawings, provide type indicated in Structural Drawings.

2.09 MASONRY-CELL INSULATION

- A. Cellular plastic foam insulation comprised of spray-dried polymeric resin and a foaming catalyst concentrate which are combined with water and then injected, along with compressed air, into the wall cavity by the installer. Subject to compliance with requirements, provide CoreFoam as manufactured by cfiFOAM, Inc, or approved equal:
 - 1. ASTM E-84 Surface Burning Characteristics
 - a. Flame Spread 25 or less.
 - b. Smoke Generated less than 450.
 - c. Thickness 3.5 inches (maximum test thickness)
 - d. Flammability Classifications: Class A
 - 2. R-value 4.0-5.0 (hr ft² °F in)/BTU; 4.92 per inch at 25 °F.
 - 3. Density upon final curing: 0.5-1.0 lb / ft³.
 - 4. Install in all cells of exterior walls between conditioned space and building exterior, except for grouted cells.
 - a. At acoustical block, provide block with grout shields behind the acoustical fill material.

2.10 MASONRY CLEANERS

- A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned. The use of muriatic acid is prohibited.
 - 1. Available Manufacturers:
 - a. Diedrich Technologies, Inc.
 - b. EaCo Chem, Inc.
 - c. ProSoCo, Inc.
 - 2. Do not use materials or methods that can damage masonry finishes. Use only manufacturer's approved products and methods.
 - a. [At resin faced units (Astra-Glaze), do not powerwash or use acid or abrasive cleaners, or steel wool, sandpaper or other abrasive materials that can damage the glazed finish.]

2.11 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.
 - 1. Do not use calcium chloride in mortar or grout.
 - 2. Limit cementitious materials in mortar to portland cement and lime.
 - 3. Limit cementitious materials in mortar for exterior masonry to portland cement and lime.
 - 4. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.
- B. Mortar for Unit Masonry: Comply with ASTM C 270, Property Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.
 - 1. For masonry below grade or in contact with earth, use Type S.
 - 2. For reinforced masonry, use Type S.
 - 3. For mortar parge coats, use Type S.
 - 4. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N.
- C. Pigmented Mortar: Use colored cement product.
 - 1. Application: Use pigmented mortar for exposed mortar joints at all brick masonry
 - 2. Final colors as approved by mock-up review.
- D. Grout for Unit Masonry: Comply with ASTM C 476.
 - 1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
 - 2. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143/C 143M.

2.12 SOURCE QUALITY CONTROL

- A. Owner will engage a qualified independent testing agency to perform source quality-control testing indicated below:
 - 1. Payment for these services will be made by Owner.
 - 2. Retesting of materials failing to comply with specified requirements shall be done at Contractor's expense.
- B. Clay Masonry Unit Test: For each type of unit furnished, per ASTM C 67.
- C. Concrete Masonry Unit Test: For each type of unit furnished, per ASTM C 140.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
 - 1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
 - 2. Verify that foundations are within tolerances specified.
 - 3. Verify that reinforcing dowels are properly placed.
- B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 COORDINATION

- A. Contractor is responsible to coordinate between trades prior to concrete slab pours to avoid conflicts with CMU wall construction, including but not limited to the following:
 - 1. Positions, sizes, and other requirements for locating all reinforcing coming up through slab. Unless otherwise noted in Structural Drawings, post-installation with epoxy anchors is not an equivalent method of installation. Any request to substitute post-installed anchors in masonry construction should be pre-approved by Contractor via RFI to the Structural Engineer of record, and the Structural Engineer may reject requests for such substitution.
 - 2. Reinforced / grouted cells will not be in conflict with electrical conduits, plumbing pipes, or other items built into CMU cells. This includes the quantity, sizes, and locations to comply with all notes, specific location details, and typical details, as indicated in the Structural Drawings.
 - a. A large number of conduits in a line could cause non-compliance with Structural requirements, either for the CMU wall, or in the concrete slab. In areas where many conduits are required for electrical items, request clarification from Architect and Structural Engineer as to allowable routings of conduits to avoid adverse impact on the structural system.
 - 3. Confirm sill sealer gaskets are installed where studs meet concrete slabs, prior to beginning veneer installation.

3.03 INSTALLATION, GENERAL

- A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.
- B. Build chases and recesses to accommodate items specified in this and other Sections.
- C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.
- D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed. Do not install any cut units at corner conditions.
- E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.
 - 1. Mix units from several pallets or cubes as they are placed.
- F. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested per ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying. Do not wet CMU.
- G. Comply with construction tolerances in ACI 530.1/ASCE 6/TMS 602 and with the following:
 - 1. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
 - 2. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
 - 3. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
 - 4. For exposed bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch. Do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.

5. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.
 6. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.
 7. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.
- H. Sound Absorbing Concrete Unit Masonry: Units shall be kept dry and installed by the General Contractor or Masonry Contractor using only mechanics skilled in the laying of masonry blocks. All necessary cutting on the job site shall be performed with power tools in such a manner as to provide straight and true edges. No chipped or broken blocks shall be used. Acoustical masonry shall be laid in running or stack bond with the open ends of the cavities facing downward and shall be seated in a full horizontal bed of mortar. The slots shall be exposed to the area where the sound absorption is desired as indicated on the plans. Care shall be taken to ensure that the slots are kept free of mortar or debris above the mortar joint. Lines shall be straight and true and the workmanship shall otherwise conform to all requirements of the General Specifications for masonry work.
1. Ensure grout shields are installed in block cells to be grouted or to receive insulating foam fill behind the acoustical material.

3.04 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
- C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4-inches. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
- D. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.
- E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- F. Fill space between steel frames and masonry solidly with mortar, unless otherwise indicated.
- G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.
- H. Fill cores in hollow concrete masonry units with grout 24 inches under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.
 1. Fill all cores of CMU at storm shelter impact-resisting perimeter walls, and any other locations so indicated in Structural Drawings.
- I. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above, unless otherwise indicated.
 1. Install compressible filler in joint between top of partition and underside of structure above.

2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide 1/2-inch clearance between end of anchor rod and end of tube. Space anchors 48 inches o.c., unless otherwise indicated.
3. Wedge non-load-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.
4. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Division 07 Section - Fire-Resistive Joint Systems.

3.05 MORTAR BEDDING AND JOINTING

- A. Lay hollow brick and concrete masonry units as follows:
 1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
 2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
 3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
 4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.
- B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
- C. Mortar joints to be tooled, except special joints as detailed.

3.06 CAVITY WALLS

- A. Bond wythes of cavity walls together using one of the following methods:
 1. Individual Metal Ties: Provide ties as shown installed in horizontal joints, but not less than one metal tie for 1.77 sq. ft. of wall area spaced not to exceed 16 inches o.c. horizontally and 16 inches o.c. vertically. Stagger ties in alternate courses. Provide additional ties within 12 inches of openings and space not more than 36 inches apart around perimeter of openings. At intersecting and abutting walls, provide ties at no more than 24 inches o.c. vertically.
 - a. Where bed joints of wythes do not align, use adjustable (two-piece) type ties.
 - b. Where one wythe is of clay masonry and the other of concrete masonry, use adjustable (two-piece) type ties to allow for differential movement regardless of whether bed joints align.
 2. Masonry Joint Reinforcement: Installed in horizontal mortar joints.
 - a. Where bed joints of both wythes align, use ladder-type reinforcement extending across both wythes.
 - b. Where bed joints of wythes do not align, use adjustable (two-piece) type reinforcement.
 - c. Where one wythe is of clay masonry and the other of concrete masonry, use adjustable (two-piece) type reinforcement to allow for differential movement regardless of whether bed joints align.
- B. Keep cavities clean of mortar droppings and other materials during construction. Bevel beds away from cavity, to minimize mortar protrusions into cavity. Do not attempt to trowel or remove mortar fins protruding into cavity.
- C. Coat cavity face of backup wythe to comply with Division 07 Section - Bituminous Dampproofing. Where indicated on drawings.
- D. Membrane Dampproofing: Re: Division 07 Section - Self Adhering Sheet Dampproofing.

3.07 MASONRY-CELL INSULATION

- A. Site Verification: Install after block mortar is adequately cured and do not install when there is water in the cells or block is wet. Install when temperature of wall assembly and other environmental requirements of Manufacturer are met.
- B. Install foam cell insulation in masonry unit cells per Manufacturer's instructions. Install insulation after laying units and before installing exterior continuous insulation, finishes, or brick veneer. Install from top and/or exterior side and patch all core holes. Install foam before applying dampproofing, or patch dampproofing after patching core holes.
- C. Field Quality Control:
 - 1. Testing
 - a. Verify insulation density by random sampling of foam.
 - b. Fill a 12x12x12 box with foam.
 - c. Foam weight should be 2 ½ - 3 ¼ lb.
 - 2. Inspection and Correction: Owner and Architect reserve the right to require verification and correction of proper installation as follows:
 - a. Owner shall engage an IR technician who is "BlockWallScanIR" certified to perform and interpret infrared scans of all insulated masonry walls. Should any deficiencies be discovered, the Installer shall be responsible to pay all costs for the testing and verification.
 - b. Installer shall correct any portion of the foam installation found not to be in compliance with manufacturer's requirements, at no additional cost to Owner.

3.08 CONCRETE MASONRY JOINT REINFORCEMENT

- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.
 - 1. Space reinforcement not more than 16 inches o.c.
 - 2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls, and at storm shelter perimeter walls forming the impact-resistant shell of the Storm Shelter.
 - 3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings.
 - a. Reinforcement above is in addition to continuous reinforcement.
- B. Interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.
- C. Provide continuity at wall intersections by using prefabricated T-shaped units.
- D. Provide continuity at corners by using prefabricated L-shaped units.
- E. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.09 ANCHORING MASONRY VENEERS

- A. Anchor masonry veneers to wall framing or concrete and masonry backup with masonry-veneer anchors to comply with the following requirements:
 - 1. Fasten screw-attached anchors through sheathing to wall framing and to concrete and masonry backup with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
 - 2. Insert slip-in anchors in metal studs as sheathing is installed. Provide one anchor at each stud in each horizontal joint between sheathing boards.
 - 3. Embed tie sections in masonry joints. Provide not less than 2 inches of air space between back of masonry veneer and face of sheathing.
 - 4. Locate anchor sections to allow maximum vertical differential movement of ties up and down.

5. Space anchors as indicated, but not more than 16 inches o.c. vertically and 16 inches o.c. horizontally, with not less than 1 anchor for each 2 sq. ft. of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 8 inches, around perimeter.
6. Provide self-sealing tape to seal around shaft of screw and legs of anchor at the point of penetration. Unless otherwise indicated in Division 07 "Air Barrier" sections, tape may be applied at each anchor or in continuous vertical strips, however continuous strips are highly recommended where exterior insulation will visually obscure the tape locations at the air barrier.

3.10 CONTROL AND EXPANSION JOINTS

- A. General: Install control and expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.
- B. Form control joints in concrete masonry as follows using one of the following methods:
 1. Fit bond-breaker strips into hollow contour in ends of concrete masonry units on one side of control joint. Fill resultant core with grout and rake out joints in exposed faces for application of sealant.
 2. Install preformed control-joint gaskets designed to fit standard sash block.
 3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar or rake out joint for application of sealant.
 4. Install temporary foam-plastic filler in head joints and remove filler when unit masonry is complete for application of sealant.
- C. Form expansion joints in brick made from clay or shale as follows:
 1. Build in compressible joint fillers where indicated.
 2. Form open joint full depth of brick wythe and of width indicated, but not less than 3/8 inch for installation of sealant and backer rod specified in Division 07 Section - Joint Sealants.
- D. Location of expansion joints:
 1. At long walls no greater than 25 feet maximum.
 2. At offsets in walls.
 3. Near corners (10 ft. maximum).
 4. At intersections of walls.
 5. Where short runs of masonry intersect long runs of masonry.
 6. Where materials of different coefficients of thermal expansion are joined.
- E. Form open joint full depth of brick wythe and of width indicated, but not less Provide horizontal, pressure-relieving joints by inserting a compressible filler of width required for installing sealant and backer rod specified in Division 07 Section - Joint Sealants, but not less than 3/8 inch.
 1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

3.11 LINTELS

- A. Install steel lintels where indicated.
- B. Provide masonry lintels where shown and where openings of more than 12 inches for brick-size units and 24 inches for block-size units are shown without structural steel or other supporting lintels.
- C. Provide minimum bearing of 8 inches at each jamb, unless otherwise indicated.

3.12 FLASHING, WEEPS, CAVITY DRAINAGE, AND VENTS

- A. General: Install embedded flashing and weeps in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. Install vents at 2'-0" on center at top of masonry walls shelf angles, ledges, and other obstructions to upward flow of air in cavities, and where indicated. Embed flashing in manufacturer's recommended sealant. Seal lap joints as recommended by manufacturer.
- B. Install flashing as follows, unless otherwise indicated:
 - 1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
 - 2. At multi-wythe masonry walls, including cavity walls, extend flashing through outer wythe, turned up a minimum of 8 inches, and through inner wythe to within 1/2 inch of the interior face of wall in exposed masonry. Where interior face of wall is to receive furring or framing, carry flashing completely through inner wythe and turn flashing up approximately 2 inches on interior face.
 - 3. At masonry-veneer walls, extend flashing through veneer, across air space behind veneer, up face of sheathing at least 8 inches, through sheathing and up back of sheathing a minimum of 4 inches.
 - 4. At lintels and shelf angles, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends, turn up and fold not less than 2 inches to create a folded end dam, per manufacturers recommendations & literature.
 - 5. Cut flexible flashing off flush with face of wall after masonry wall construction is completed and reviewed by architect.
- C. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.
- D. Install weeps in head joints in exterior wythes of first course of masonry immediately above embedded flashing and as follows:
 - 1. Use specified weep/vent products to form weeps.
 - 2. Form weeps above flashing under brick sills.
 - 3. Space weeps 24 inches o.c., unless otherwise indicated.
- E. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in Part 2 "Miscellaneous Masonry Accessories" Article. At a minimum, place Mortar Net to a height equal to the height of the first course, but not less than 8 inches. Place immediately above the top of flashings embedded in the wall, as masonry construction progresses, to catch mortar droppings and to maintain drainage.
- F. Install vents in head joints in exterior wythes at spacing indicated. Use specified weep/vent products to form vents.
 - 1. Close cavities off vertically and horizontally with blocking in manner indicated. Install through-wall flashing and weep holes above horizontal blocking.
- G. Install sill sealer at sill plate per manufacturer's written instructions.

3.13 REINFORCED UNIT MASONRY INSTALLATION

- A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
 - 1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.

2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other temporary loads that may be placed on them during construction.
- B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.
- C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
 1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
 2. Limit height of vertical grout pours to not more than 60 inches.

3.14 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
 2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
 3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
 4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
 5. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
 6. Where required clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
 7. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

3.15 MASONRY WASTE DISPOSAL

- A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.
- B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.
 1. Crush masonry waste to less than 4 inches in each dimension.
 2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Division 31 Section - Earthwork.
 3. Do not dispose of masonry waste as fill within 18 inches of finished grade.

END OF SECTION 04 81 00

SECTION 04 43 00 - STONE MASONRY

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. General Coordination Procedures, (Reference Specification Section 01 31 00) General Contractor shall coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work that depend on each other for proper installation, connection, and operation.

1.02 SUMMARY

- A. Section Includes:
 - 1. Provide stone exterior wall material, laid up like masonry, as shown on the Drawings and as specified herein.
- B. Related Sections include the following:
 - 1. Division 05 Section - Steel Lintels, loose.
 - 2. Division 07 Section - Flashing, Sheet Metal.
 - 3. Division 07 Section - Sealants.

1.03 SUBMITTALS

- A. Submit shop drawings per requirements of Division 01 Section, showing layout and details of construction, anchors, jointing and setting.
- B. Submit three 12" x 12" samples of each type of finish of stone specified, showing full range of colors, for approval by Architect.
- C. Copies of complete data on stone fabricator. Architect reserves the right to reject the fabricator if adequate past experience in the production of the types of units specified is not assured by the data submitted.
- D. Copies of supplier's specifications and test data for type of stone required, including certification that stone complies with the specified requirements. Include instructions for handling, storage, installation and protection of stone.
- E. Copies of complete data showing all colors, textures and finishes available.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Protect mortar materials from moisture absorption and damage; reject damaged containers.
- B. Store sand to prevent inclusion of foreign matter.
- C. Delivery of Materials:
 - 1. Carefully pack and unload stone with necessary caution to avoid damaging or soiling stone.
 - 2. Deliver stone in original package or pallets, plainly marked with identification of materials and manufacturer.
- D. Storage of Materials:
 - 1. Store stone minimum of 4 inches above ground on non-staining skids made of non-chemically treated wood or of wood not containing tannin.
 - 2. Provide non-staining spacers between pieces and polyethylene or other suitable film as protective covering.
 - 3. Cover stone on all sides and bottom with waterproof paper, clean canvas or polyethylene.

4. Protect mortar materials from moisture absorption and damage; reject damaged containers.
5. Store sand to prevent inclusion of foreign matter.

1.05 JOB CONDITIONS

- A. Coordinate stonework with other trades whose work relates to this section, in any manner, for placing of all required backing, blocking and leave-outs, etc.
- B. Masonry work shall not be placed when there is any possibility of the water freezing before it has attained its initial set. In weather below freezing, all masonry units and mortar shall be heated. Walls which have frozen after making their initial set shall not be built upon until they have had sufficient time to make a proper set at temperatures above freezing.
- C. All newly placed masonry shall be protected against damage from action of the elements and under no condition shall rain be allowed to fall on, drive against or flow down masonry surfaces until mortar has set a minimum of 12 hours. Tops of all walls shall be covered with a waterproof material at the end of each day.
- D. All newly placed stone shall be protected from damage of any sort.

1.06 QUALITY ASSURANCE

- A. Qualification of fabricator: Obtain each stone from single quarry source, with accepted color range and texture throughout the work as established by approved samples.
- B. Sources or kinds of materials as approved shall not be changed during course of work.
- C. Stone fabricator shall have successfully fabricated work similar to quality specified in quantity shown for period of not less than 5 years.
- D. Stone fabricator shall have been engaged in the business of fabricating stone specified for a period of not less than (5) years. Provide reference including project name, project architect and General Contractor.
- E. Installer Qualifications: A qualified installer who employs experienced stonemasons and stone fitters, with at least 5 years' documented experience in installing stone masonry of the type, scope, and complexity as required for this project.
- F. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified:
 1. ASTM C 97, Absorption and Bulk Specific Gravity of Natural Building Stone
 2. ASTM C 99, Modulus of Rupture of Natural Building Stone
 3. ASTM C 170, Compressive Strength of Natural Building Stone.
 4. Masonry Institute of America Handbook for Marble & Stone Slab Veneer.
- G. Pre-Installation Meeting: Convene a pre-installation meeting at least one week prior to commencing Work of this Section.
- H. Mockups: Build free standing pre-construction mockup [s] to verify selections made under Sample submittals, demonstrate understanding of the complete wall construction, demonstrate typical construction and waterproofing details, demonstrate aesthetic effects, and to set quality standards for materials and execution.
 1. Build mockup [s] as shown on drawings, including face and backup wythes, fenestrations, flashings and accessories.. Comply with requirements in Section 01 43 39 "Mockups".
 - a. Prior to product installation a field-constructed mock-up shall be provided under the provisions of Division 1 Section - Submittals, Product Data, Samples and Mock-ups, to verify details & tie-ins, and to demonstrate the required quality of materials and installation.

- b. Construct a typical exterior wall section, incorporating back-up wall, cladding, window and sill, insulation, flashing and any other critical junctions (roof, foundation, etc.) as detailed in Drawings at typical wall locations as located by Architect.
 - c. Locate mockups as directed by Architect.
 - d. Build mockups as indicated in Drawings.
 - 1) Show typical components, attachments to building structure, and methods of installation.
 - e. Obtain Architect's approval of mockups before starting installation.
 - f. Approval of mockups does not constitute approval of deviations from the Contract Documents unless Architect specifically approves such deviations in writing.
 - g. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 - h. Demolish and remove mockups when directed.
2. Clean exposed faces of mockups with masonry cleaner as indicated.
 3. Protect accepted mockups from the elements with weather-resistant membrane.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. All stone shall be standard grade, free from cracks, seams or other imperfections which might impair its structural integrity and finish. All stone furnished must conform to and be within the range of approved samples. Cut accurately to shape and dimensions shown on final shop drawings. Variations on surfaces from true plane shall not exceed 1/8" for smooth finish.
- B. Stone: Design for stone is based on products as distributed through Upchurch Kimbrough Company, Contact: Laura Langley (laural@upchurchkimbrough.com / 512-560-7988)
 1. Color, texture and finish within range of samples approved by Architect.
 2. Color Blend: New Braunfels FS 7 Exterior ST2 Blend
 - a. Thickness: 3" – 5" W
 - b. Texture: Chopped Face
 - c. Coursing: Random Ashlar
 - d. Sizes: Sawn top and bottom, 4" / 6 " / 8" H x random length
- C. Materials and Finishes: Match accepted samples approved by Architect.
 1. Stone #1 _____
 2. Material _____
 3. Cut _____
 4. Finish _____
 5. Stone #2 _____
 6. Material _____
 7. Cut _____
 8. Finish _____

2.02 ACCESSORIES

- A. Anchors: Fabricate anchors, including shelf angles, from stainless steel, ASTM A240/A240M or ASTM A666, [Type 304] [Type 316]; temper as required to support loads imposed without exceeding allowable design stresses. Fabricate dowels and pins for anchors from stainless steel, ASTM A276, [Type 304] [Type 316].
- B. Spacers: Impact resistant plastic (1/4" max. thickness)
- C. Membrane Flashings: 32 mil thick rubberized asphalt laminated to 8 mil polyethylene film, release paper facing, self adhering
- D. Joint Sealers: Specified in Division 07 Section.

- E. Cleaning Solution: type that will not harm stone, joint material, or adjacent surfaces.

2.03 FABRICATION

- A. Cut adjacent pieces from same block wherever possible.
- B. Provide kerf slot in top and bottom of panels.
- C. Form stone corners to miter kerf joint profile.
- D. Anchorage:
 - 1. Space anchors at maximum 24 inches on center and around perimeter.
 - 2. Minimum number of anchors: four per panel.
- E. Fabrication Tolerances
 - 1. Variation in width or height: plus or minus 1/8 inch
 - 2. Variation in thickness: plus or minus 1/8 inch
 - 3. Variation in form true plane: plus or minus 1/16 inch in 3 feet

PART 3 - EXECUTION

3.01 INSPECTION

- A. Inspect foundations to assure surfaces to support masonry are to proper grades and elevations, free of dirt or uneven surfaces. Examine all subsurfaces to receive stone work. Report in writing to General Contractor, with a copy to Architect, any conditions. Verify surfaces are free of all imperfections which may prove detrimental to the work. Commencement of work will be construed as acceptance of all subsurfaces.

3.02 PREPARATION

- A. Establish lines, levels and coursing. Protect from disturbance.
- B. Clean stone prior to installation. Do not use wire brushes or implements that can mark or damage exposed surfaces.
- C. Wet absorptive stone in preparation for placement to minimize moisture suction from mortar.

3.03 STONE INSTALLATION

- A. Install in accordance with American Limestone Co., Dallas, TX (214) 747-2636 ALC-2000 Veneer System Manual.
- B. Arrange stone pattern to provide color uniformity and constant joint sizes throughout.
- C. Set stone plumb and level. Align adjacent pieces in same plane.
- D. All anchors shall be concealed.
- E. Coordinate with other trades for placement of inserts and anchors. Provide templates or drawings as required.
- F. Execute work with skilled mechanics and employ skilled fitters at site to do necessary field cutting as stone is set.
- G. Provide openings and other spaces as shown or required for contiguous work. Close up openings in stone after other work is in place. Use materials and set to match surrounding work.
- H. Set stone in accordance with final shop drawings.
- I. Have all work done by competent stone masons and to appearance approved by Architect.
- J. Remove and replace damaged or defective stonework to match adjacent acceptable stonework.

3.04 FLASHINGS AND WEEP HOLES

- A. All flashings installed in accordance with herein specified requirements and in accordance with manufacturer's recommendations so that all flashing works properly and drains water to the outside.
- B. Provide smooth mortar beds, slightly pitched to the outside face of the wall at all points where flashings are to be installed over horizontal surfaces.
- C. Flashing shall extend beyond outside face of wall as detailed on drawings.
- D. At lintels and shelf angles, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends, turn up and fold not less than 2 inches to create a folded end dam, per manufacturers recommendations & literature
- E. Install weep vents in vertical joint of first course above flashings at 24" o.c.
- F. Flashing to be installed with top edge extending behind sheathing as detailed on drawings.

3.05 CONTROL & SOFT JOINTS

- A. Make adequate provisions throughout the stone work for expansion and contraction. Install preformed control joint gasket, extending from top of bearing surface to top of wall, reinforcing shall not run through.
- B. Install soft joint material at top of stone.

3.06 SEALED JOINTS

- A. Outside joints at the perimeter of exterior door and window frames shall not be less than 1/4" nor more than 3/8" wide and shall be cleaned out to a uniform depth of at least 3/4" for sealant, provided under Division 07 Section.

3.07 BUILT-IN WORK

- A. Contractor shall carefully examine architectural and mechanical drawings providing all slots, chases, recesses in masonry work as required. No pipes shall be enclosed unless tested.

3.08 INSTALLATION TOLERANCES

- A. Maximum variation from level and plumb: 1/8 inch in 10 feet, noncumulative.
- B. Maximum variation in plane between adjacent pieces as joint: Plus or minus 1/16 inch.

3.09 CLEANING

- A. Clean stone with stiff brushes and water.
- B. If initial cleaning does not produce acceptable results, apply cleaner in accordance with manufacturer's instructions
 1. Prior to applying, clean sample panel in area as directed by Architect. If approved, use same materials and techniques for cleaning remainder of stone.
 2. Protect adjacent surfaces.
 3. Wet stone prior to applying cleaner.
 4. Thoroughly rinse surfaces with water after completion of cleaning: remove all traces of cleaning solution.

3.10 PROTECTION

- A. Protect stonework from soiling and damage during all phases of construction.

END OF SECTION 04 43 00

SECTION 04 72 00 - CAST STONE MASONRY

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. General Coordination Procedures, (Reference Specification Section 01 31 00) General Contractor shall coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work that depend on each other for proper installation, connection, and operation.

1.02 SUMMARY

- A. Section Includes:
 - 1. This specification covers all labor, materials and services incidental to and including the furnishing and setting of all Cast Stone as indicated on the drawings and specified herein.
 - 2. The Manufacturer shall be responsible for all labor, materials, equipment and services necessary for an incidental to providing all Cast Stone covered by this Specification.
 - 3. The Setting Contractor shall unload, receipt for, protect, store and set all Cast Stone covered by this Specification and shall provide and install all anchors for same.
- B. Related Sections:
 - 1. Division 04 Section - Unit Masonry Assemblies, for miscellaneous masonry accessories.
 - 2. Division 05 Section - Cold-Formed Metal Framing, for steel stud frames supporting dimension stone cladding.
 - 3. Division 07 Section - Fluid Applied Membrane Air Barriers, for membranes applied to exterior face of exterior sheathing at exterior masonry cavity walls.
 - 4. Division 07 Section - Sheet Metal Flashing and Trim, for exposed sheet metal flashing.
 - 5. Division 07 Section - Firestopping, for firestopping at openings in masonry walls.
 - 6. Division 07 Section - Joint Sealants, for sealing control and expansion joints in unit masonry.
 - 7. Division 07 Section - Thermal Insulation, for cavity wall insulation.

1.03 SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. For cast stone units, include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: Show fabrication and installation details for cast stone units. Include dimensions, details of reinforcement and anchorages if any, and indication of finished faces. Tie cast stone locations to building gridlines for verification of dimensions.
 - 1. Include building elevations showing layout of units and locations of joints and anchors.
 - 2. Show locations and details of flashing at a scale no less than 3 inches per 12 inches.
- C. Samples for Initial Selection: Submit manufacturer's full range of color options.
- D. Samples for Verification:
 - 1. For each color and texture of cast stone required, 10 inches square in size.
 - 2. For colored mortar. Make Samples using same sand and mortar ingredients to be used on Project. Label Samples to indicated types and amounts of pigments used.
- E. Full-Size Samples: For each color, texture, and shape of cast stone unit required.
 - 1. Make available for Architect's review at Project site.

1.04 QUALITY ASSURANCE

- A. The Manufacturer shall have been a recognized and reputable Cast Stone manufacturer for a minimum of five years continuous operation, and shall have adequate experience, facilities and capacity to furnish the quality, sizes and quantity of Cast Stone required without delaying the progress of the work. The Manufacturer's products shall have been previously used and exposed to the weather with satisfactory results.
- B. Standards: Comply with the requirements of the Cast Stone InstituteSM Technical Manual and the project specifications. Where a conflict may occur, the contract documents shall prevail.
- C. All Cast Stone used in this work shall be manufactured by cast stone manufacturer and shall have minimum compressive strength of 6500 lbs. per square inch and absorption of no greater than 6% when tested in accordance with the requirements of this Specification.
- D. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.
- E. Source Limitations for Cast Stone: Obtain cast stone units through single source from single manufacturer.
- F. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color, from one manufacturer for each cementitious component and from one source or producer for each aggregate.
- G. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Build mockup of typical wall area as shown on Drawings.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Coordinate delivery of cast stone with unit masonry work to avoid delaying the Work and to minimize the need for on-site storage.
- B. Pack, handle, and ship cast stone units in suitable packs or pallets.
 - 1. Lift with wide-belt slings; do not use wire rope or ropes that might cause staining. Move cast stone units, if required, using dollies with wood supports.
 - 2. Store cast stone units on wood skids or pallets with nonstaining, waterproof covers, securely tied. Arrange to distribute weight evenly and to prevent damage to units. Ventilate under covers to prevent condensation.
- C. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- D. Store mortar aggregates where grading and other required characteristics can be maintained and contamination can be avoided.

1.06 PROJECT CONDITIONS

- A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Comply with cold-weather construction requirements in ACI 530.1/ASCE 6/TMS 602.
 - 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and above and will remain so until cast stone has dried, but no fewer than seven days after completing cleaning.
- B. Hot-Weather Requirements: Comply with hot-weather construction requirements in ACI 530.1/ASCE 6/TMS 602.

PART 2 - PRODUCTS

2.01 CAST STONE MATERIALS

- A. General: Comply with ASTM C 1364 and the following:
- B. Portland Cement: ASTM C 150, Type I or Type III, containing not more than 0.60 percent total alkali when tested according to ASTM C 114. Provide natural color or white cement as required to produce cast stone color indicated.
- C. Coarse Aggregates: Granite, quartz, or limestone complying with ASTM C 33; gradation and colors as needed to produce required cast stone textures and colors.
- D. Fine Aggregates: Natural sand or crushed stone complying with ASTM C 33, gradation and colors as needed to produce required cast stone textures and colors.
- E. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.
- F. Admixtures: Use only admixtures specified or approved in writing by Architect.
 - 1. Do not use admixtures that contain more than 0.1 percent water-soluble chloride ions by mass of cementitious materials. Do not use admixtures containing calcium chloride.
 - 2. Use only admixtures that are certified by manufacturer to be compatible with cement and other admixtures used.
 - 3. Air-Entraining Admixture: ASTM C 260. Add to mixes for units exposed to the exterior at manufacturer's prescribed rate to result in an air content of 4 to 6 percent, except do not add to zero-slump concrete mixes.
- G. Reinforcement: Deformed steel bars complying with ASTM A 615/A 615M, Grade 60. Use galvanized or epoxy-coated reinforcement when covered with less than 1-1/2 inches of cast stone material.
 - 1. Epoxy Coating: ASTM A 775/A 775M.
 - 2. Galvanized Coating: ASTM A 767/A 767M.
- H. Embedded Anchors and Other Inserts: Fabricated from stainless steel complying with ASTM A 240/A 240M, ASTM A 276, or ASTM A 666, Type 304.

2.02 CAST STONE UNITS

- A. Manufacturers: Subject to compliance with requirements, provide products by the one of the following or approved equal:
 - 1. Advanced Architectural Stone Inc. (AAS), 115 Lee Street, Fort Worth, Texas 76140, (817) 572-0012 Fax (817) 293-6378, Email: sales@advancedarchitecturalstone.com, URL: www.advancedarchitecturalstone.com.
 - 2. AHI Supply, LP, 2800 North Gordon, Alvin, Texas 77511, (281) 331-0088 Fax (281) 331-9813, Email: arhoden@ahi-supply.com, URL: www.ahi-supply.com.
 - 3. Continental Cast Stone of Texas Inc., 101 E Shady Grove Rd, Grand Prairie, Texas 75050, (972) 871-7866 Fax (972) 871-1251, Email: info@continentalcaststone.com.
 - 4. Stone Castle Industries Inc., 3615 Almeda Genoa, Houston, Texas 77047, (713) 440-6224 Fax (713) 440-6228, URL: www.stonecastleinc.com.
- B. Provide cast stone units complying with ASTM C 1364 using either the vibrant dry tamp method.
 - 1. Provide units that are resistant to freezing and thawing as determined by laboratory testing according to ASTM C 666/C 666M, Procedure A, as modified by ASTM C 1364.
- C. Fabricate units with sharp arris and accurately reproduced details, with indicated texture on all exposed surfaces unless otherwise indicated.
 - 1. Slope exposed horizontal surfaces 1:12 to drain unless otherwise indicated.
 - 2. Provide raised fillets at backs of sills and at ends indicated to be built into jambs.
 - 3. Provide drips on projecting elements unless otherwise indicated.

D. Fabrication Tolerances:

1. Variation in Cross Section: Do not vary from indicated dimensions by more than 1/8 inch.
2. Variation in Length: Do not vary from indicated dimensions by more than 1/360 of the length of unit or 1/8 inch, whichever is greater, but in no case by more than 1/4 inch.
3. Warp, Bow, and Twist: Not to exceed 1/360 of the length of unit or 1/8 inch, whichever is greater.
4. Location of Grooves, False Joints, Holes, Anchorages, and Similar Features: Do not vary from indicated position by more than 1/8 inch on formed surfaces of units and 3/8 inch on unformed surfaces.

E. Cure units as follows:

1. Cure units in enclosed moist curing room at 95 to 100 percent relative humidity and temperature of 100 deg F for 12 hours or 70 deg F for 16 hours.
2. Keep units damp and continue curing to comply with one of the following:
 - a. No fewer than five days at mean daily temperature of 70 deg F or above.
 - b. No fewer than six days at mean daily temperature of 60 deg F or above.
 - c. No fewer than seven days at mean daily temperature of 50 deg F or above.
 - d. No fewer than eight days at mean daily temperature of 45 deg F or above.

F. Acid etch units after curing to remove cement film from surfaces to be exposed to view.

G. Colors and Textures: As selected by Architect from manufacturer's full range

2.03 MORTAR MATERIALS

A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

B. Hydrated Lime: ASTM C 207, Type S.

C. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C 979. Use only pigments with a record of satisfactory performance in masonry mortar.

1. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Davis Colors; True Tone Mortar Colors.
 - 2) Lanxess Corporation; Bayferrox Iron Oxide Pigments.
 - 3) Solomon Colors, Inc.; SGS Mortar Colors.

D. Aggregate for Mortar: ASTM C 144.

1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.

2.04 ACCESSORIES

A. Anchors: Type and size indicated, fabricated from Type 304 stainless steel complying with ASTM A 240/A 240M, ASTM A 276, or ASTM A 666.

B. Dowels: 1/2-inch- diameter, round bars, fabricated from Type 304 stainless steel complying with ASTM A 240/A 240M, ASTM A 276, or ASTM A 666.

2.05 MORTAR MIXES

A. Comply with requirements in Division 04 Section - Unit Masonry for mortar mixes.

1. Use masonry cement mortar unless otherwise indicated.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 SETTING CAST STONE IN MORTAR

- A. Set cast stone as indicated on Drawings. Set units accurately in locations indicated with edges and faces aligned according to established relationships and indicated tolerances.
 - 1. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure units in place.
 - 2. Coordinate installation of cast stone with installation of flashing specified in other Sections.
- B. Wet joint surfaces thoroughly before applying mortar or setting in mortar.
- C. Set units in full bed of mortar with full head joints unless otherwise indicated.
 - 1. Set units with joints 1/4 to 3/8 inch wide unless otherwise indicated.
 - 2. Build anchors and ties into mortar joints as units are set.
 - 3. Fill dowel holes and anchor slots with mortar.
 - 4. Fill collar joints solid as units are set.
 - 5. Build concealed flashing into mortar joints as units are set.
 - 6. Keep head joints in coping and other units with exposed horizontal surfaces open to receive sealant.
 - 7. Keep joints at shelf angles open to receive sealant.
- D. Rake out joints for pointing with mortar to depths of not less than 3/4 inch. Rake joints to uniform depths with square bottoms and clean sides. Scrub faces of units to remove excess mortar as joints are raked.
- E. Point mortar joints by placing and compacting mortar in layers not greater than 3/8 inch. Compact each layer thoroughly and allow it to become thumbprint hard before applying next layer.
- F. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
- G. Provide sealant joints at copings and other horizontal surfaces, at expansion, control, and pressure-relieving joints, and at locations indicated.
 - 1. Keep joints free of mortar and other rigid materials.
 - 2. Build in compressible foam-plastic joint fillers where indicated.
 - 3. Form joint of width indicated, but not less than 3/8 inch.
 - 4. Prime cast stone surfaces to receive sealant and install compressible backer rod in joints before applying sealant unless otherwise indicated.
 - 5. Prepare and apply sealant of type and at locations indicated to comply with applicable requirements in Division 07 Section - Joint Sealants.

3.03 SETTING ANCHORED CAST STONE WITH SEALANT-FILLED JOINTS

- A. Set cast stone as indicated on Drawings. Set units accurately in locations indicated with edges and faces aligned according to established relationships and indicated tolerances.
 - 1. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure units in place.
 - 2. Shim and adjust anchors, supports, and accessories to set cast stone in locations indicated with uniform joints.

- B. Keep cavities open where unfilled space is indicated between back of cast stone units and backup wall; do not fill cavities with mortar or grout.
- C. Fill anchor holes with sealant.
 - 1. Where dowel holes occur at pressure-relieving joints, provide compressible material at ends of dowels.
- D. Set cast stone supported on clip or continuous angles on resilient setting shims. Use material of thickness required to maintain uniform joint widths. Hold shims back from face of cast stone a distance at least equal to width of joint.
- E. Keep joints free of mortar and other rigid materials. Remove temporary shims and spacers from joints after anchors and supports are secured in place and cast stone units are anchored. Do not begin sealant installation until temporary shims and spacers are removed.
 - 1. Form open joint of width indicated, but not less than 3/8 inch.
- F. Prime cast stone surfaces to receive sealant and install compressible backer rod in joints before applying sealant unless otherwise indicated.
- G. Prepare and apply sealant of type and at locations indicated to comply with applicable requirements in Division 07 Section - Joint Sealants.

3.04 INSTALLATION TOLERANCES

- A. Variation from Plumb: Do not exceed 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
- B. Variation from Level: Do not exceed 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
- C. Variation in Joint Width: Do not vary joint thickness more than 1/8 inch in 36 inches or one-fourth of nominal joint width, whichever is less.
- D. Variation in Plane between Adjacent Surfaces (Lipping): Do not vary from flush alignment with adjacent units or adjacent surfaces indicated to be flush with units by more than 1/16 inch, except where variation is due to warpage of units within tolerances specified.

3.05 ADJUSTING AND CLEANING

- A. Remove and replace stained and otherwise damaged units and units not matching approved Samples. Cast stone may be repaired if methods and results are approved by Architect.
- B. Replace units in a manner that results in cast stone matching approved Samples, complying with other requirements, and showing no evidence of replacement.
- C. In-Progress Cleaning: Clean cast stone as work progresses.
 - 1. Remove mortar fins and smears before tooling joints.
 - 2. Remove excess sealant immediately, including spills, smears, and spatter.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed cast stone as follows:
 - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
 - 2. Test cleaning methods on sample; leave one sample uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of cast stone.
 - 3. Clean cast stone by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.

END OF SECTION 04 72 00

SECTION 05 50 00 - METAL FABRICATIONS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. General Coordination Procedures, (Reference Specification Section 01 31 00) General Contractor shall coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work that depend on each other for proper installation, connection, and operation.

1.02 SUMMARY

- A. General: Furnish all labor, supervision, materials, tools, equipment, appliances and services necessary for the fabrication, delivery and installation of all miscellaneous metal items. All work shall be as shown or indicated on the drawings and as specified in this section.
- B. Scope of Work:
 - 1. Embedded angles and plates
 - 2. Guardrails, Handrails, and Handrail Brackets
 - 3. Stair Treads and Nosings
 - 4. Ladders
 - 5. Steel Equipment Supports
 - 6. Metal Gratings
 - 7. Steel Plate Covers for Sidewalk Culverts
 - 8. Pipe Guards
 - 9. Pipe Bollards
 - 10. Vehicular Sign Posts
 - 11. Steel Gate Frames
 - 12. Miscellaneous metal work and related items.
 - 13. Shop Priming of Metal Fabrications
- C. Related Sections include the following:
 - 1. Division 03 Section - Concrete.
 - 2. Division 04 Section - Unit Masonry.
 - 3. Division 05 Section - Metal Pan Stairs.
 - 4. Division 06 Section - Rough Carpentry, for concealed blocking for attachment of metal fabrications.
 - 5. Division 07 Section - Roof Accessories
 - 6. Division 08 Section - Access Doors
 - 7. Division 09 Section - Painting.
 - 8. Division 09 Section - Special Coatings.

1.03 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design ladders miscellaneous supports and railings, including engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Design Criteria:
 - 1. Ladders and stairs designed to withstand live loading conditions of 100 lb. per square feet.

2. Handrails, Guardrails, or other protective enclosures shall be designed to withstand stresses to which they would be normally subjected, and to support a load of 50 lb per linear foot applied perpendicular at the top of the rail or guard, and to withstand a load of 200 lbs. applied in any direction at any point on the top of the rail or guard without deflection.
3. Connections other than those already listed shall be designed to safely support design load (dead load plus live load) of not less than 100 psi without exceeding working stresses permitted for materials.
4. Design ladders to include platforms and safety cages where shown in Drawings and where required by local code and authorities having jurisdiction.
5. Miscellaneous countertop supports designed to safely support a load of 200 lb per linear foot of countertop applied at the outside edge, as well as any additional requirements as specified in Division 06 Section - Architectural Woodwork.
6. Miscellaneous equipment supports per local code requirements, equipment Manufacturers' requirements and as specified herein.

1.04 QUALITY ASSURANCE

- A. Steel stairs in accordance with latest NAAMM Standards and AISC.
- B. Welding shall conform to American Welding Society's Standard Code for Arc and Gas Welding in Building Construction. Welding shall be continuous along entire area of contact, except where tack welding is specifically shown or specified. Grind all exposed welds.

1.05 SUBMITTALS

- A. Shop drawings based on the Contract Documents shall be submitted to the Architect for review prior to ordering of materials.
- B. Failure by the contractor to submit shop drawings, test reports, etc. required above shall release the Architect and the Engineer from any liabilities due to the negligence on the part of the contractor to comply with the construction documents.
- C. Approval will cover size and arrangement of members, character of construction, but not dimensions.
- D. Contractor shall verify actual dimensions at the construction site.

PRODUCTS

1.06 MATERIALS

- A. Comply with the following standards, as pertinent:
 1. Steel plates, shapes, and bars: ASTM A36;
 2. Steel plates to be bent or cold-formed: ASTM A283; grade C;
 3. Steel tubing (hot-formed, welded, or seamless): ASTM A500; grade B;
 4. Steel bars and bar-size shapes: ASTM A306; grade 65, or ASTM A36;
 5. Cold-finished steel bars: ASTM A1081
 6. Cold-rolled carbon steel sheets: ASTM A336;
 7. Galvanized carbon steel sheets: ASTM A526, with G90 zinc coating in accordance with ASTM A525;
 8. Stainless steel sheets: AISI type 302 or 304, 24 ga. with number 4 finish;
 9. Gray iron castings: ASTM A48, class 10;
 10. Malleable iron castings: ASTM A47;
 11. Steel pipe: ASTM A53, grade A, schedule 40, black finish unless otherwise noted;
 12. Concrete inserts:

- a. Threaded or wedge-type galvanized ferrous castings of malleable iron complying with ASTM A27.
 - b. Provide required bolts, shims, and washers, hot-dip galvanized in accordance with ASTM A153.
- 13. Bolts and nuts: Provide hexagon-head regular type complying with ASTM A307, grade A.
- 14. Lag bolts: Provide square-head type complying with Fed Spec FF-B-561;
- 15. Machine screws: Provide cadmium plated steel type complying with Fed Spec FF-S-111.
- B. Castings shall be made from the best grade of soft pig iron cast in stove place molding sand to a uniform thickness. Castings shall be free of defects impairing strength or appearance.
- C. Accessories: Provide all anchors bolts, anchor straps, hangers and other related fittings, fastener and accessories required for proper and secure installation of all miscellaneous metal. Fasteners for exterior use shall be zinc coated. Generally, the sizes, shapes and spacing of items are shown or specified; where not shown or specified, accessories shall be adequate for the required services, subject to approval.

1.07 ITEMS TO BE PROVIDED

- A. Lintel Angles and Bent Plates: Galvanized steel in sizes indicated on Drawings. Extend loose lintel angles 8" on each side of opening.
- B. Steel Pipe Guardrails: 1-1/4" Standard steel pipe as detailed in Drawings. Hot-dipped galvanized steel at all exterior railings.
 - 1. Except where specifically detailed otherwise, railings in new concrete shall be mounted to cast-in galvanized steel sleeves. Field painted (refer to Division 09 – "High Performance Coatings").
 - 2. At removeable sections of guardrail, extend galvanized pipe sleeve up 2" above concrete slab and provide set screws. Tap drill sleeve and removeable guardrail legs to match set screw and provide secure attachment. Fabricate removable sections of railing in not greater than 6' wide sections.
 - 3. At mezzanine guardrails, concrete edge should have a steel plate or bent plate edge extending 1/2" above concrete floor level, to inhibit small items being kicked off the mezzanine, below the low rail of the guardrails. Refer to Structural and Architectural Drawings and coordinate as required.
- C. Steel Pipe Hand Railings: 1-1/4" Standard steel pipe fabricated with welded and round smooth connections as illustrated on Drawings or as required. Hot-dipped, galvanized steel pipe at all exterior hand railings, galvanize railings after fabrication. All railings to have closed ends.
 - 1. Where railings do not return to post or to a vertical or horizontal surface, provide domed ends.
 - 2. Except where specifically detailed otherwise, railings in new concrete shall be mounted to cast-in galvanized steel sleeves.
 - 3. Heavy Duty Handrail Brackets: Model 386, as manufactured by Julius Blum & Co
 - 4. Provide any other attachments to new and existing construction as required to comply with design loading criteria.
- D. Countertop Support Frames: Provide welded steel support frame for wide countertops without intermediate supports as indicated in Drawings, and as indicated in Division 6, Section - Architectural Woodwork. Provide steel tube posts located inside adjacent wall framing, with steel tube, channel, or angle horizontal beneath countertop as indicated in Drawings. Steel sizes indicated in Drawings are minimum sizes allowed; provide larger sizes where required to meet performance criteria and delegated design. The depth of the horizontal member must be designed to fit concealed behind the front vertical side of the

- countertop. Design connection to floor slab to support indicated loading and to fit within wall framing dimensions. Pre-drill for screw attachment / connection of countertop underlayment as directed by millwork fabricator / installer.
- E. Miscellaneous Equipment Supports: Field verify all dimensions and provide miscellaneous steel support structure for wall and ceiling mounted equipment as follows:
1. For ceiling mounted projector mounts, and locations and items as specifically detailed or other items called for in the Drawings or other Sections requiring miscellaneous steel supports for complete installation.
 2. For large ceiling fans as indicated in Drawings.
 3. Where not specifically detailed, design and provide supports as required for all other equipment to be provided or installed under this contract.
 4. All supports shall comply with requirements of the equipment Manufacturer(s) for support structure and shall provide adequate strength and secure attachment to building structure, braced against lateral movement.
- F. Metal Gratings:
1. Metal Gratings at sump pump pit at elevator: Hot Dipped Galvanized, 1-1/4" x 3/16" steel bearing bar at 1-3/16" on center with cross members welded at 4" on center, equal to McNichols Co. GW 125.
 - a. Width: As indicated in drawings, and overall width as required to fit opening.
 - b. Orient bearing bars to span in short span direction.
 - c. Bar banded ends on each section to prevent wracking.
 2. At gratings in walk surfaces, orient grating so that short dimension of openings are perpendicular to the path of travel, and in compliance with Texas Accessibility Standards.
- G. Sidewalk Culvert: 3/8" galvanized checkerplate sidewalk culvert cover with countersunk screws.
- H. Sidewalk Trench Cover & Frame: Standard support frame and bolted down solid checkered top of Gray Iron, Class 35 shall be Neenah Foundry Co., "Light Duty" Series #R-4991 with Type D skid resistant top, or approved equal by Barry Pattern & Foundry, Campbell, or McKinley Iron Works, in sizes as shown on drawings.
- I. Downspout Adaptors: A1 Downspout Adaptor as manufactured by Piedmont Pipe Construction, Inc. Denver, NC. (877) 489-0911 or approved equal. Stainless steel material. Size as required to transition from downspout to underground piping.
- J. Pipe Bollards: 6" Diameter galvanized schedule 40 steel pipe with concrete fill. Mound concrete at top of bollard to shed water.
1. Size: 7'-0" in length, recessed 3'-0" below-grade. 4'-0" height above grade, unless otherwise indicated in Drawings.
 2. Paint: Refer to Division 09, Section "Painting". Colors: as selected by Architect.
- K. Miscellaneous Steel Shapes: Channels, angles, plates, tubing, connections and bolts provided where shown and detailed on drawings. Exterior imbed plates, support angles, and other miscellaneous exterior steel shall be hot-dip galvanized.

1.08 METAL LADDERS

- A. General:
1. Comply with ANSI A14.3 unless otherwise indicated.
 2. For elevator pit ladders, comply with ASME A17.1.
- B. Steel Ladders:
1. Space siderails 16 inches apart unless otherwise indicated.

2. Space rungs of elevator pit ladders 12 inches apart.
3. Siderails: Continuous, 3/8-by-2-1/2-inch steel flat bars, with eased edges.
4. Rungs: 3/4-inch diameter steel bars.
5. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
6. Provide nonslip surfaces on top of each rung, either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.
7. Provide nonslip surfaces on top of each rung by coating with abrasive material metallically bonded to rung.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) MEBAC, by IKG Industries, a division of Harsco Corporation.
 - 2) SlipNOT, SlipNOT Metal Safety Flooring, a W. S. Molnar company.
8. Support each ladder at top and bottom and not more than 60 inches with welded or bolted steel brackets.

1.09 SHOP PAINTING

- A. All Iron and Steel Work: Unless otherwise specified, power tool clean all surfaces to remove mill scale. Work shall receive a shop coat of paint before leaving the factory or being exposed to the weather. Aluminum work contacting dissimilar metals shall receive a protective coating preventing galvanic action.
- B. Shop Paint: Shop paint shall be Fabricator's standard, fast curing, lead free, "universal" primer, compatible with finish paint system indicated and for capability to provide sound foundation for field applied topcoats.
- C. Aluminum surfaces to be in direct contact with concrete and masonry shall be shop coated with zinc chromate primer.

PART 2 - EXECUTION

2.01 FABRICATION

- A. Contractor shall secure and be responsible for all field measurements required for the proper and accurate fabrication and installation of the items included under this section; field alterations will not be permitted except upon specific authorization of the Architect.
- B. All work shall be assembled in the most substantial manner and reinforced where necessary with structural shapes, using concealed screws, bolts or similar fastenings. Make welds of adequate strength and durability, jointing tight, clean and smooth, flush and in true plane with base metals.
- C. All screws or rivets shall be countersunk, unless otherwise noted. Provide lock washers for all bolts.
- D. All steel to which wood blocking is connected shall be properly punched for anchoring blocking.
- E. Exposed steel shapes with marred surfaces shall be ground or draw-filled to a fine grain finish, as approved before applying shop coat of paint.
- F. Assembled work shall be completely constructed in the shop, accurately finished and the pieces match-marked for erection. Form exterior joints to exclude water, grind connections in exposed pieces smooth and polish.
- G. The Contractor shall do all drilling, cutting, tapping and fitting of work to accommodate other work coming in contact with it, and shall furnish all taps, bolts and other fittings in connection therewith.

- H. Except where otherwise noted, fastening to concrete, solid masonry or hollow masonry shall be with expansion bolts or anchors. Fastening to wood plugs will not be permitted. Toggle bolts may be used only when approved by the Architect.

2.02 INSTALLATION, GENERAL

- A. All work included in this Contract shall be installed by the Contractor at the proper time and as rapidly as the progress of the adjacent and connecting work will permit.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true to line, and free of rack; and measured from established lines and levels.
- C. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- E. Field Welding:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
 - 5. Touch-up shop prime coats.
- F. Immediately after erection, clean the field welds, bolted connections, and abraded areas of shop priming. Paint the exposed areas with same material used for shop priming.
- G. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:
 - 1. Cast Aluminum: Heavy coat of bituminous paint.
 - 2. Extruded Aluminum: Two coats of clear lacquer.

2.03 INSTALLATION, SPECIFIC ITEMS

- A. Miscellaneous Framing and Supports:
 - 1. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.
 - 2. Anchor supports securely to and rigidly brace from building structure.
- B. Metal Pipe Bollards:
 - 1. Anchor bollards in concrete. Fill annular space around bollard solidly with nonshrink, nonmetallic grout; mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8 inch toward bollard for positive drainage away from bollard base.
 - 2. Fill bollards solidly with concrete, mounding top surface to shed water.
 - 3. Paint bollards color(s) as approved by architect.

2.04 ADJUSTING AND CLEANING

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

END OF SECTION 05 50 00

SECTION 07 11 13 - BITUMINOUS DAMPPROOFING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. General Coordination Procedures, (Reference Specification Section 01 31 00) General Contractor shall coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work that depend on each other for proper installation, connection, and operation.

1.02 SUMMARY

- A. Section Includes:
 - 1. Cold-applied, emulsified-asphalt dampproofing.
 - a. At masonry backup for veneer masonry cavity walls.
 - b. At grade beams below grade, with drainage course to french drain.
 - c. At retaining walls, with free draining aggregate and french drain.
- B. Related Sections include the following:
 - 1. Division 04 Section - Unit Masonry Assemblies.
 - 2. Division 07 Section Self Adhering Sheet Waterproofing, for waterproofing system at building grade beams and walls below grade.
 - 3. Division 07 Sections for other waterproofing, air barrier, and weather barrier systems.
 - 4. Division 07 Section - Sheet Metal Flashing and Trim.
 - 5. Division 31 and 33 Sections for filter fabric, free draining aggregate and french drains.

1.03 ACTION SUBMITTALS

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

1.04 FIELD CONDITIONS

- A. Weather Limitations: Proceed with application only when existing and forecasted weather conditions permit dampproofing to be performed according to manufacturers' written instructions.
- B. Ventilation: Provide adequate ventilation during application of dampproofing in enclosed spaces. Maintain ventilation until dampproofing has cured.

PART 2 - PRODUCTS

2.01 MATERIALS, GENERAL

- A. Source Limitations: Obtain primary dampproofing materials and primers from single source from single manufacturer. Provide protection course molded-sheet drainage panels and auxiliary materials recommended in writing by manufacturer of primary materials.
- B. VOC Content: Products shall comply with VOC content limits of authorities having jurisdiction unless otherwise required.

2.02 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. BASF Construction Chemicals - Building Systems; Sonneborn Brand Products.
 - 2. ChemMasters, Inc.
 - 3. Euclid Chemical Company (The); an RPM company.
 - 4. Henry Company.
 - 5. Karnak Corporation.
 - 6. Koppers Inc.
 - 7. Malarkey Roofing Products.
 - 8. Meadows, W. R., Inc.
- B. Basis of Design shall be a heavy bodied, non-sag coating with short fibers for application with Fibered Brush, Roller or Spray, in compliance with ASTM D-1227, Type II, Class 1, equal to BASF's "MasterSeal 615".

2.03 AUXILIARY MATERIALS

- A. General: Furnish auxiliary materials recommended in writing by dampproofing manufacturer for intended use and compatible with bituminous dampproofing.
- B. Emulsified-Asphalt Primer: ASTM D 1227, Type III, Class 1, except diluted with water as recommended in writing by manufacturer.
- C. Asphalt-Coated Glass Fabric: ASTM D 1668, Type I.
- D. Patching Compound: Asbestos-free fibered mastic of type recommended in writing by dampproofing manufacturer.
- E. Protection Course at grade beams below grade: ASTM D 6506, 1/8-inch- thick, semirigid sheets of fiberglass or mineral-reinforced-asphaltic core, pressure laminated between two asphalt-saturated fibrous liners.
- F. Protection Course at retaining walls: Smooth-surfaced roll roofing complying with ASTM D 6380, Class S, Type III.

2.04 MOLDED-SHEET DRAINAGE PANELS

- A. Geotextile-Faced, Molded-Sheet Drainage Panel: Composite subsurface drainage panel consisting of a 40% post-industrial recycled polypropylene drainage core of fused, entangled filaments, with a geocomposite fabric facing bonded to one side with an opening size not exceeding No. 70 sieve, and a vertical flow rate of 9 to 22 gpm per ft. Provide termination bar and sheet metal flashing cap for panels installed with top edge above grade. The Basis of Design product shall be "Enkadrain 3611R", as manufactured by Colband Inc., Enka, NC (800) 365-7391.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions with Applicator present, for compliance with requirements for surface smoothness, surface moisture, and other conditions affecting performance of bituminous dampproofing work.
- B. Proceed with application only after substrate construction and penetrating work have been completed and unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Mask or otherwise protect adjoining exposed surfaces from being stained, spotted, or coated with dampproofing. Prevent dampproofing materials from entering and clogging weep holes and drains.
- B. Clean substrates of projections and substances detrimental to the dampproofing work; fill voids, seal joints, and remove bond breakers if any, as recommended in writing by prime material manufacturer.
- C. Apply patching compound to patch and fill tie holes, honeycombs, reveals, and other imperfections.

3.03 APPLICATION, GENERAL

- A. Comply with manufacturer's written instructions for dampproofing application, cure time between coats, and drying time before backfilling unless more stringent requirements are indicated.
 - 1. Apply dampproofing to provide continuous plane of protection.
 - 2. Apply additional coats if recommended in writing by manufacturer or to achieve a smooth surface and uninterrupted coverage.
- B. Where dampproofing footings and foundation walls, apply from finished-grade line to bottom of grade beam
 - 1. At footings, extend over top of footing and down a minimum of 6 inches over outside face of footing.
 - 2. Extend dampproofing 12 inches onto intersecting walls and footings, but do not extend onto surfaces exposed to view when Project is completed.
 - 3. Install flashings and corner protection stripping at internal and external corners, changes in plane, construction joints, cracks, and where shown as "reinforced," by embedding an 8-inch- wide strip of asphalt-coated glass fabric in a heavy coat of dampproofing. Dampproofing coat for embedding fabric is in addition to other coats required.
- C. Where dampproofing exterior face of inner wythe of exterior masonry cavity walls, lap dampproofing at least 1 inch onto flashing, and 1/4 inch onto masonry reinforcement, veneer ties, and other items that penetrate inner wythe.
 - 1. Extend dampproofing over outer face of structural members and concrete slabs that interrupt inner wythe.
 - 2. Lap dampproofing at least 1/2 inch onto shelf angles supporting veneer.
 - 3. At metal flashings installed with termination bar to exterior face of masonry, strip in bituminous felts. Lap felts at least 2" over metal flashing and continuously seal top of felt strip to masonry with dampproofing.
- D. Where dampproofing of cavity walls adjoins other dampproofing or air barrier or weather barrier materials, coordinate with adjacent material installer to provide continuous weatherproofing barrier and to avoid incompatible materials coming in contact with each other. Take care not to apply or spill dampproofing on surfaces to receive incompatible weatherization membranes.

3.04 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

- A. Concrete Foundations: Apply trowel coat at not less than 4 gal./100 sq. ft..
- B. Unexposed Face of Masonry Retaining Walls: Apply primer as recommended by manufacturer for substrates indicated, and one brush or spray coat at not less than 1.25 gal./100 sq. ft.

- C. Concrete and Masonry Backup for Veneer Assemblies: Apply primer as recommended by manufacturer for substrates indicated, and one brush or spray coat at not less than 1 gal./100 sq. ft.

3.05 INSTALLATION OF PROTECTION COURSE

- A. Where indicated, install protection course over completed-and-cured dampproofing. Comply with dampproofing-material and protection-course manufacturers' written instructions for attaching protection course.
 - 1. Install protection course within 24 hours of installation of dampproofing (while coating is tacky) to ensure adhesion.

3.06 INSTALLATION OF MOLDED-SHEET DRAINAGE PANELS

- A. Place and secure molded-sheet drainage panels, with geotextile facing away from wall substrate, according to manufacturer's written instructions. Use adhesives or other methods that do not penetrate dampproofing. Lap edges and ends of geotextile to maintain continuity. Protect installed molded-sheet drainage panels during subsequent construction.
 - 1. Install protection course before installing drainage panels.
- B. Where indicated to extend above grade, install top edge of drainage panel with mechanically attached termination bar and prefinished sheet metal flashing cap.

3.07 CLEANING

- A. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

END OF SECTION 07 11 13

SECTION 07 62 00 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. General Coordination Procedures, (Reference Specification Section 01 31 00) General Contractor shall coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work that depend on each other for proper installation, connection, and operation.

1.02 SUMMARY

- A. Section Includes:
 - 1. Provide all metal flashing and sheet metal work, as shown on the drawings and as herein specified.
- B. Related Sections include the following:
 - 1. Division 04 Section - Unit Masonry for through-wall flashing.
 - 2. Division 06 Section - Rough Carpentry for blocking, nailers, etc.
 - 3. Division 07 Section - Joint Sealers.
 - 4. Division 07 Section - Painting.
 - 5. Division 07 Section - Roofing for flashing membranes.
 - 6. Division 07 Section - Metal Roof Panels for sheet metal flashing and trim integral with metal roof panels.
 - 7. Division 07 Section - Metal Wall Panels for sheet metal flashing and trim integral with metal wall panels.
 - 8. Division 07 Section - Roof Specialties for manufactured roof specialties not part of sheet metal flashing and trim.
 - 9. Division 07 Section - Roof Accessories for set-on-type curbs, equipment supports, roof hatches, vents, and other manufactured roof accessory units.
 - 10. Division 07 Section - Expansion Control for manufactured sheet metal expansion-joint covers.

1.03 PERFORMANCE REQUIREMENTS AND QUALITY ASSURANCE

- A. General: Sheet metal flashing and trim assemblies shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.
- B. Sheet Metal Standard for Flashing and Trim: Comply with the latest edition of NRCA's "The NRCA Roofing Manual" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.
- C. Fabricated copings and roof edge flashings: Roof edge flashings shall be designed without exposed fasteners, including at the inside face of copings, and as follows:
 - 1. Wind-Uplift Resistance: Provide metal roof edge flashing assemblies that comply with UL 580 for wind-uplift-resistance class indicated.
 - a. Uplift Rating: UL 90.
 - 2. SPRI Wind Design Standard: Fabricated copings and roof edge flashings for low slope roofs shall be designed and installed for wind loads in accordance with IBC Chapter 16,

including local code amendments as applicable, and tested for resistance in accordance with Test Methods RE-1, RE-2 and RE-3 of ANSI/SPRI/FM 4435/ES-1.

- a. Roof edge products shall be UL Classified by Underwriters Laboratories, Inc. or other building code approved 3rd party verification of compliance with the ANSI/SPRI/FM 4435/ES-1 Wind Design Standard.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss. Account for temperature change of 120 deg F ambient, 180 deg F material surfaces.
- E. Installer: Engage an experienced installer who has completed similar work of a comparable scale with a record of successful performance.

1.04 GUARANTEE

- A. Sheet metal applicator and General Contractor shall personally guarantee sheet metal work for a period of Two-Years after acceptance of the building by the Owner against any defects or water leaks. Guarantee shall include all labor and materials necessary to correct any defects or water leaks upon notice from the Owner.
- B. Furnish manufacturer's standard 20 year warranty stating architectural fluorocarbon finish will be:
 1. Free of fading of color change in excess of 6 NBS units as measured per ASTM D 2244-68;
 2. Will not chalk in excess of numerical rating of 7 when measured in accordance with standard procedures specified in ASTM D 659-74;
 3. Will not peel, crack, chip, or de-laminate.

1.05 SUBMITTALS

- A. Division 01 Section - Submittal Procedures: Procedures for submittals.
- B. Submit shop drawings for review and approval prior to ordering of materials and fabrication of the required shapes and metal flashings. Submittal for the coping system is required.
- C. Failure by the contractor to submit shop drawings required above shall release the Architect from any liabilities due to the negligence on the part of the Contractor to comply with the construction documents.
- D. Samples: Submit samples of sheet metal flashings, trim, copings, accessory items, and prefabricated items of profiles, gauge and finish to be used.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Sheet metal for receivers and counter-flashings: 24 gauge or as noted on drawings galvanized sheet steel bent to required shapes.
- B. Sheet metal for downspouts, leader boxes, scuppers, eave flashing, copings, gutters, drip edges and similar exposed items shall be 20 gauge hot-dip galvanized sheet steel. Bend to required shapes.
- C. Lead: Weight 4 lbs. per square foot.
- D. Solder: ASTM D32, Alloy gauge 58, 50% tin, 50% lead.

- E. Gutter, Downspout and Fascia at Canopies and Metal Roofing: 20 Gauge galvanized steel with Kynar 500 coating. Provide 1" straps at 30" o.c. and bracket hangers at 30" o.c. Gutter to be color as selected by Architect.
- F. Shop-Fabricated Coping System: Minimum of 24 Gauge galvanized steel pre-formed, prefinished cap installed over drainable 20 gauge galvanized steel perforated cleat, 12" wide at 60" centers. Increase minimum gauges of cap and cleats, and decrease cleat spacing as required to meet specified standards and performance criteria. Cleat secured with nails into P.T. wood blocking. Internal supports and concealed splice plates. Basis of Design construction shall be patterned on the OMG Roofing Products "Permasnap-2" Coping System. Cap shall receive Kynar coating in color to be selected by the Architect. Provide continuous welded pre-formed corners and intersections.
 - 1. Coping: Fabricated from minimum 24 gauge galvanized, prefinished steel unless otherwise noted.
 - 2. Coping Corners and Intersections: Mitered, preformed and continuously welded.
 - 3. Cleats: Fabricated from same material as coping.
 - 4. Splice Plates: Concealed, of the same material and finish as coping.
 - 5. Finish for Galvanized Steel: Kynar coating in colors as selected by Architect.
- G. Shop-Fabricated Fascia: 20 Gauge galvanized steel pre-formed fascia installed over roofing membrane. Basis of Design construction shall be as profiled on the drawings.
 - 1. Fascia Cover: Fabricated from 20 Gauge galvanized steel, prefinished unless otherwise noted.
 - 2. Corners: Mitered, preformed and continuously welded.
 - 3. Splice Plates: Concealed, of same material, finish, and shape as fascia cover.
 - 4. Finish for Galvanized Steel: Kynar coating in colors as selected by Architect.
- H. Finish for Galvanized Steel: Kynar coating in colors as selected by Architect.
- I. Nails for Sheet Metal Work: 10 Gauge galvanized ring type steel of sufficient length to adequately secure sheet metal work.
- J. Aluminum Trim Fasteners: Exposed fasteners shall be aluminum or stainless steel. Unexposed fasteners may be cadmium or zinc plated steel in accordance with ASTM A164-55 and 165-55. Steel anchors shall be properly insulated from aluminum.
- K. Roof Penetration Flashing: Lead coated copper 16 oz./SF. Roof Penetration Flashing: Lead coated copper 16 oz. /SF.
- L. Through-Wall, Door/Window Sill and Head Flashings:
 - 1. Where embedded in masonry (not exposed to view): 3 oz. copper composite Multi-Flash 500 by York or approved equal. See Division 4 section "Unit Masonry".
 - 2. Where exposed to view: Prefinished 24 gauge galvanized steel with PVDF coating in color(s) as selected by Architect. Provide with drip edges hemmed 1/2" on underside.
- M. Metal Jamb Flashing: Provide 18 gauge prefinished metal, with hemmed edge.
- N. Reglets: Equal to Fry original metal reglet.
- O. Counter Flashing. "Springlock Flashing" by Fry Reglet.
- P. Sheet Metal Fasteners: Galvanized steel with washers where required.

2.02 FABRICATION

- A. All exposed edges shall be hemmed 1/2" on underside.

2.03 ALUMINUM FINISHES

- A. General: Comply with Aluminum Association's (AA) "Designation System for Aluminum Finishes: for finish designations and application recommendations.
- B. High-Performance Organic Coating Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid chromate-fluoride-phosphate conversion coating; Organic Coating; as specified below). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturer's instructions.
 - 1. Fluoropolymer 2-Coat Coating system: Manufacturer's standard 2-coat, thermo cured system composed of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 605.2.
 - a. Color and Gloss: As selected by Architect from manufacturer's full range of choices for color and gloss.

PART 3 - EXECUTION

3.01 INSPECTION OF SURFACES

- A. Applicator responsible for inspecting substrates upon which sheet metal materials are to be placed for any defects or conditions that would impair finished installation. Application constitutes acceptance of the substrate.

3.02 APPLICATION

- A. Details shown are design details, fabrication techniques, and methods as per SMACNA recommendations.
- B. Proper and adequate provisions shall be made in fabrication, installing and fastening sheet metal work for expansion and contraction of metal and other materials entering into the work so that pulling, splitting, opening of joints, warpage or other failure of the work shall be prevented. Expansion joints in sheet metal placed not farther than 40 feet apart. Dissimilar metal surfaces contacting one another, protected by bituminous coating to prevent galvanic or corrosive action from occurring.
- C. Counter flashing constructed in lengths not exceeding 10 feet and installed in receiver so that flashing lays tightly against base flashing and overlaps base flashings a minimum of 4 inches. Joints between sections shall be tight and lay flat. Metal at corners continuous. Bent, crimped or warped sections are not permitted.
 - 1. Coordinate counterflashings with roofing installation of termination bars at top edge of roofing base flashings.
- D. Coping constructed in lengths not exceeding 10 feet. Joints between sections shall be tight and lay flat over splice plates. Coping shall be fastened with continuous clips both sides over 45 mil neoprene sheet. Bent, crimped or warped sections are not permitted. Metal at corners shall be soldered.

3.03 INSTALLATION

- A. General: unless otherwise indicated, install sheet metal flashing and trim to comply with performance requirements, manufacturer's installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Anchor units of Work securely in place by method indicated, providing for thermal expansion of metal units; conceal fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weatherproof.
 - 1. All complete work shall be water and weathertight. Joints, cuts, miters, splices or other installation means made as neat as possible. Fastenings as inconspicuous as possible.

- B. Install exposed sheet metal Work that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicate, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
- C. Expansion Provisions: Provide for thermal expansion of exposed sheet metal work. Space movement joints at maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions in Work cannot be used or would not be sufficiently weatherproof and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).
- D. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1-1/2 inches, except where pre-tinned surface would show in finished Work.
 - 1. Do not solder the following metals:
 - a. Aluminum.
 - 2. Pre-tinning is not required for the following metals:
 - a. Lead-coated copper.
 - 3. Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.
- E. Copings: Install with concealed splice plates, preformed corners, and positive drainage (inward slope) on top surface. No exposed fasteners through copings allowed.
- F. Sealed Joints: Form no expansion, but movable, joints in metal to accommodate elastomeric sealant to comply with SMACNA standards. Fill joint with sealant and form metal to completely conceal sealant.
 - 1. Use joint adhesive for nonmoving joints specified not to be soldered.
- G. Seams: Fabricate nonmoving seams in aluminum with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
- H. Separations: Separate metal from noncompatible metal or corrosive substrates by coating concealed surfaces, at locations of contact, with asphalt mastic or other permanent separation as recommended by manufacturer.
 - 1. Underlayment: Where installing stainless steel or aluminum directly on cementitious or wood substrates, install a slip sheet of red-rosin paper and a course of polyethylene underlayment.
 - 2. Bed flanges of Work in a thick coat of roofing cement where required for waterproof performance.
- I. Roof-drainage System: Install drainage items fabricated from sheet metal, with straps, adhesives, and anchors recommended by SMACNA'S Manual or the item manufacturer, to drain roof in the most efficient manner. Coordinate roof-drain flashing installation with roof-drainage system installation. Coordinate flashing and sheet metal items for steep-sloped roofs with roofing installation.
- J. Roof-Penetration Flashing; Coordinate roof-penetration flashing installation with roofing and installation of items penetrating roof. Install flashing as follows:
 - 1. Turn lead flashing down inside vent piping, being careful not to block vent piping with flashing.
 - 2. Seal and clamp flashing to pipes penetrating roof, other than lead flashing on vent piping.

3.04 FLASHING & COUNTERFLASHING REQUIREMENTS

- A. Joints in thru-wall flashings and counterflashings shall be lapped 4" minimum with laps bedded in sealant.
- B. Head and sill flashings shall not have joints and shall have sides turned up (edge dams) with all corners folded, not cut and shall extend 9" minimum beyond both sides of opening.
- C. Head, sill and thru-wall flashings shall be set in a bead of sealant applied under the exterior edge of the flashing and on top of the masonry or lintel angle on which the flashing rests.
- D. Penetrations in thru-wall flashing are not permitted. Vents in thru-wall flashing shall be completely flashed and water tight.
- E. Metal reglets shall have a bead of sealant installed to complete system with counterflashing.
- F. All thru-wall flashing shall extend through and up the interior face of exterior gypsum sheathing, as applicable.
- G. Install metal jamb flashing, in material as noted, over adjacent air barrier system at jambs of curtainwall and other locations as shown on the drawings, as required to close openings to cavity wall. Mechanically attach with stainless steel fasteners and seal metal flashing to wall / air barrier with self adhering membrane flashing as specified in Division 07 Section - Modified Bituminous Sheet Air Barriers.

3.05 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces, removing substances that might cause corrosion of metal or deterioration of finishes.

END OF SECTION 07 62 00

SECTION 07 92 00 - JOINT SEALANTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. General Coordination Procedures, (Reference Specification Section 01 31 00) General Contractor shall coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work that depend on each other for proper installation, connection, and operation.

1.02 SUMMARY

- A. Section Includes: Provide sealant required to close joints that would allow moisture or air to enter structure between fixed materials, as shown on the drawings and as herein specified, including but not limited to:
 - 1. Sealing of interior perimeter joints of window framing, door frames, and other openings in walls.
 - 2. Sealing interior and exterior walls to floor or roof decking/construction for fire resistive or thermal, moisture or acoustical barrier.
 - 3. Setting of thresholds in sealant.
 - 4. Sealing of joints between countertops and wall surfaces for a sanitary joint.
 - 5. Sealing of joints of every nature and description that would allow moisture or air penetration.
 - 6. Sealing of joints indicated to be caulked or sealed whether specifically mentioned herein or not.
 - 7. Sealing around all pipe, duct and vent penetrations.
 - 8. Sealing at paving joints.
- B. Related Sections include the following:
 - 1. Division 04 Section - Unit Masonry Assemblies.
 - 2. Division 07 Sections – Thermal and Moisture Resistant Barriers
 - 3. Division 07 Section - Sheet Metal Flashing and Trim.
 - 4. Division 07 Section - Expansion Control.
 - 5. Division 09 Section - Painting.
 - 6. Division 22 Section - Plumbing.
 - 7. Division 23 Section - Mechanical.
 - 8. Division 26 Section - Electrical.
 - 9. Division 32 Section - Paving.

1.03 JOB CONDITIONS

- A. Environmental Conditions: Sealant work not permitted when air temperature is below 40 degrees F.

1.04 SUBMITTALS

- A. Product Data: Submit manufacturer's product specifications, color range, handling/installation/curing instructions, and performance tested data sheets for each elastomeric product or joint backing material.

- B. Samples: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- C. Submit samples of joint backing material.

1.05 WARRANTY

- A. The Contractor shall submit, in writing, a warrant that all sealant work executed under this Section shall be free from defects in materials and workmanship for a period of two (2) years from date of acceptance of the Project, and he shall remedy any defects in the sealant work during the warranty period.

PART 2 - PRODUCTS

2.01 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

2.02 MATERIALS

- A. Chemical Compatibility, General: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- B. Primers: Non-staining type as recommended by sealant manufacturer for each working surface. Material shall not leave residue or stain on adjacent surfaces. Each joint must be primed prior to sealing.
- C. Sealant for Interior and Exterior Masonry Control Joints: 2 part urethane sealant equivalent to "MasterSeal NP-2" by Sonneborne / BASF Chemical Co., "Dymeric 240" by Tremco, or "Dyna Trol II" by Pecora. Color to match adjacent surfaces.
- D. Sealant for Exterior Concrete Paving and Sidewalk Joints: Two part urethane (self leveling) sealant equal to "MasterSeal SL-2" by Sonneborne / BASF Chemical Co., "Urexpan NR-200" by Pecora, or "THC-900" Tremco. Provide non-sag product at joints in vertical curbs, equal to "MasterSeal NP-2" by Sonneborne / BASF.
- E. Precompressed Expanding Foam Sealant: Shall be Gray "Illmod 600" as manufactured by "Tremco", Beachwood, Ohio or approved equal.
- F. Joint Backing: ASTM C1330, Non-staining closed cell polyethylene foam rod oversized 30% to 50%, equal to "MasterSeal 920" by BASF.
- G. Solvents and Cleaning Agents: Of a type specifically recommended by sealant manufacturer.

PART 3 - EXECUTION

3.01 COORDINATION AND INSPECTION

- A. Coordinate sealing requirements with all trades for complete fire resistive, thermal, moisture, aesthetic or acoustical barriers and trim.
- B. Applicator shall examine surfaces receiving sealant or caulking for any defects or joint sizes which would not structurally perform or for any unusual conditions which would interfere with proper installation of sealant or caulking.

3.02 PREPARATION

- A. Thoroughly clean all joints removing all foreign matter such as dust, oil, grease, dirt or other loose particles. Provide and apply non-staining primer as required by conditions and sealant manufacturer.
- B. When primer is dry, compress backup and insert into joint leaving 1/4" to surface open for joint sealing or leave open 1/2 of joint width, but not less than 1/4".
- C. Completely cut smooth and remove projection of existing gasket and/or sealant material at door and window framing to remain to achieve sound substrate for application.

3.03 APPLICATION

- A. It is the intent and purpose and interpretation of this specification that in all areas, joints sealed shall be rendered structurally sound and impervious to the passage of water, moisture and dust.
- B. Follow sealant manufacturer's instructions regarding mixing, surface application, priming and application procedure.
- C. Sealant shall be applied under pressure with a hand or power activated gun having a nozzle of proper size to entirely fill joint void and shall be forced into joints with sufficient pressure to expel air and fill the joints solidly. All joint surfaces shall be neatly tooled to a smooth surface, free of wrinkles and result in a flush joint when dry.
- D. Apply sealants when the ambient temperature is between 40° and 100° F.
- E. All junctures between countertops, back splashes and walls shall be caulked with silicone sealant providing a sanitary tight joint.
- F. All junctures between piping and substrate of partitions, floors and ceiling shall be caulked.
- G. Precompressed expanding foam sealant shall be installed per manufacturer's requirements at all vertical expansion joints as noted on Drawings.
- H. Apply sealant bead at least 1/2 inch thick under each edge of threshold. Remove excess and neatly point.
- I. Apply sealant between brick veneer and coping on outside face of exterior wall.
- J. Caulk perimeter of window frame, door frame or other items penetrating, intersecting or abutting walls, ceilings, floors, etc.
- K. Prime surface as required and apply sealant at all glazing, at metal to metal and glass to metal joints within the system.
- L. Backer Rod shall be used in all joints, product to be constructed of closed cell foam, or appropriate resilient material for sealant. Dimension shall be minimum 30% greater than joint width, unless otherwise indicated on details.
- M. Fill paving sealant full width of joint, and to within 1/8" of paving surface.

3.04 CLEANING

- A. Clean adjacent surfaces free of sealant or soiling resulting from this work as work progresses. Use solvent or cleaning agent as recommended by sealant manufacturer. All finished work shall be left in a neat, clean condition.

END OF SECTION 07 92 00

SECTION 08 71 00 – DOOR HARDWARE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section includes:
 - 1. Mechanical and electrified door hardware for:
 - a. Swinging doors.
 - 2. Electronic access control system components, including:
 - a. Electronic access control devices.
 - 3. The intent of the hardware specification is to specify the hardware for interior and exterior doors, and to establish a type, continuity, and standard of quality. However, it is the door hardware supplier's responsibility to thoroughly review existing conditions, schedules, specifications, drawings, and other Contract Documents to verify the suitability of the hardware specified.
- B. Related Sections:
 - 1. Division 01 Section "Alternates" for alternates affecting this section.
 - 2. Division 07 Section "Joint Sealants" for sealant requirements applicable to threshold installation specified in this section.
 - 3. Division 08 Section "Entrances and Storefront" for hardware requirements applicable to installation of hardware to entrance doors
 - 4. Division 26 sections for connections to electrical power system and for low-voltage wiring.
 - 5. Division 28 sections for coordination with other components of electronic access control system.

1.03 REFERENCES

- A. UL - Underwriters Laboratories
 - 1. UL 10B - Fire Test of Door Assemblies
 - 2. UL 10C - Positive Pressure Test of Fire Door Assemblies
 - 3. UL 1784 - Air Leakage Tests of Door Assemblies
 - 4. UL 305 - Panic Hardware
- B. DHI - Door and Hardware Institute
 - 1. Sequence and Format for the Hardware Schedule
 - 2. Recommended Locations for Builders Hardware
 - 3. Key Systems and Nomenclature
- C. ANSI - American National Standards Institute
 - 1. ANSI/BHMA A156.1 - A156.29, and ANSI/BHMA A156.31 - Standards for Hardware and Specialties

1.04 SUBMITTALS

- A. General:
 - 1. Submit in accordance with Conditions of Contract and Division 01 requirements.

2. Highlight, encircle, or otherwise specifically identify on submittals deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.
 3. Prior to forwarding submittal, comply with procedures for verifying existing door and frame compatibility for new hardware, as specified in PART 3, "EXAMINATION" article, herein.
- B. Action Submittals:
1. Product Data: Technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
 2. Riser and Wiring Diagrams: After final approval of hardware schedule, submit details of electrified door hardware, indicating:
 - a. Wiring Diagrams: For power, signal, and control wiring and including:
 - 1) Details of interface of electrified door hardware and building safety and security systems.
 - 2) Schematic diagram of systems that interface with electrified door hardware.
 - 3) Point-to-point wiring.
 - 4) Risers.
 3. Samples for Verification: If requested by Architect, submit production sample or sample installations of each type of exposed hardware unit in finish indicated, and tagged with full description for coordination with schedule.
 - a. Samples will be returned to supplier. Units that are acceptable to Architect may, after final check of operations, be incorporated into Work, within limitations of key coordination requirements.
1. Door Hardware Schedule: Submit schedule with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule as published by the Door and Hardware Institute. Indicate complete designations of each item required for each door or opening, include:
 - b. Door Index; include door number, heading number, and Architects hardware set number.
 - c. Opening Lock Function Spreadsheet: List locking device and function for each opening.
 - d. Quantity, type, style, function, size, and finish of each hardware item.
 - e. Name and manufacturer of each item.
 - f. Fastenings and other pertinent information.
 - g. Location of each hardware set cross-referenced to indications on Drawings.
 - h. Explanation of all abbreviations, symbols, and codes contained in schedule.
 - i. Mounting locations for hardware.
 - j. Door and frame sizes and materials.
 - k. Name and phone number for local manufacturer's representative for each product.
 - l. Operational Description of openings with any electrified hardware (locks, exits, electromagnetic locks, electric strikes, automatic operators, door position switches, magnetic holders or closer/holder units, and access control components). Operational description should include operational descriptions for: egress, ingress (access), and fire/smoke alarm connections.
 - 1) Submittal Sequence: Submit door hardware schedule concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate fabrication of other work that is critical in Project construction schedule.
4. Key Schedule:

- a. After Keying Conference, provide keying schedule listing levels of keying as well as explanation of key system's function, key symbols used and door numbers controlled.
 - b. Use ANSI/BHMA A156.28 "Recommended Practices for Keying Systems" as guideline for nomenclature, definitions, and approach for selecting optimal keying system.
 - c. Provide 3 copies of keying schedule for review prepared and detailed in accordance with referenced DHI publication. Include schematic keying diagram and index each key to unique door designations.
 - d. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.
 - e. Provide one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion.
 - 1) Forward bitting list, key cuts and key system schematic directly to Owner, by means as directed by Owner.
 - f. Prepare key schedule by or under supervision of supplier, detailing Owner's final keying instructions for locks.
5. Templates: After final approval of hardware schedule, provide templates for doors, frames and other work specified to be factory or shop prepared for door hardware installation.
- C. Informational Submittals:
1. Qualification Data: For Supplier, Installer and Architectural Hardware Consultant.
 2. Product data for electrified door hardware:
 - a. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.
 3. Certificates of Compliance:
 - a. UL listings for fire-rated hardware and installation instructions if requested by Architect or Authority Having Jurisdiction.
 - b. Installer Training Meeting Certification: Letter of compliance, signed by Contractor, attesting to completion of installer training meeting specified in "QUALITY ASSURANCE" article, herein.
 - c. Electrified Hardware Coordination Conference Certification: Letter of compliance, signed by Contractor, attesting to completion of electrified hardware coordination conference, specified in "QUALITY ASSURANCE" article, herein.
 4. Warranty: Special warranty specified in this Section.
- D. Closeout Submittals:
1. Operations and Maintenance Data: Provide in accordance with Division 01 and include:
 - a. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
 - b. Catalog pages for each product.
 - c. Factory order acknowledgement numbers (for warranty and service)
 - d. Name, address, and phone number of local representative for each manufacturer.
 - e. Parts list for each product.
 - f. Final approved hardware schedule, edited to reflect conditions as-installed.
 - g. Final keying schedule
 - h. Copies of floor plans with keying nomenclature
 - i. As-installed wiring diagrams for each opening connected to power, both low voltage and 110 volts.
 - j. Copy of warranties including appropriate reference numbers for manufacturers to identify project.

1.05 QUALITY ASSURANCE

- A. Supplier Qualifications and Responsibilities: Recognized architectural hardware supplier with record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this Project and that provides certified Architectural Hardware Consultant (AHC) available to Owner, Architect, and Contractor, at reasonable times during the Work for consultation.
 - 1. Warehousing Facilities: In Project's vicinity.
 - 2. Scheduling Responsibility: Preparation of door hardware and keying schedules.
 - 3. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
 - 4. Coordination Responsibility: Assist in coordinating installation of electronic security hardware with Architect and electrical engineers and provide installation and technical data to Architect and other related subcontractors.
 - a. Upon completion of electronic security hardware installation, inspect and verify that all components are working properly.
- B. Architectural Hardware Consultant Qualifications: Person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and meets these requirements:
 - 1. For door hardware, DHI-certified, Architectural Hardware Consultant (AHC).
 - 2. Can provide installation and technical data to Architect and other related subcontractors.
 - 3. Can inspect and verify components are in working order upon completion of installation.
 - 4. Capable of producing wiring diagrams.
 - 5. Capable of coordinating installation of electrified hardware with Architect and electrical engineers.
- C. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.
- D. Fire-Rated Door Openings: Provide door hardware for fire-rated openings that complies with NFPA 80 and requirements of authorities having jurisdiction. Provide only items of door hardware that are listed products tested by Underwriters Laboratories, Intertek Testing Services, or other testing and inspecting organizations acceptable to authorities having jurisdiction for use on types and sizes of doors indicated, based on testing at positive pressure and according to NFPA 252 or UL 10C and in compliance with requirements of fire-rated door and door frame labels.
- E. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction.
- F. Accessibility Requirements: For door hardware on doors in an accessible route, comply with governing accessibility regulations cited in "REFERENCES" article, herein.
- G. Keying Conference
 - 1. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including:
 - a. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
 - b. Preliminary key system schematic diagram.
 - c. Requirements for key control system.
 - d. Requirements for access control.
 - e. Address for delivery of keys.
- H. Pre-installation Conference
 - 1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 2. Inspect and discuss preparatory work performed by other trades.

3. Inspect and discuss electrical roughing-in for electrified door hardware.
 4. Review sequence of operation for each type of electrified door hardware.
 5. Review required testing, inspecting, and certifying procedures.
- I. Coordination Conferences:
1. Installation Coordination Conference: Prior to hardware installation, schedule and hold meeting to review questions or concerns related to proper installation and adjustment of door hardware.
 2. Electrified Hardware Coordination Conference: Prior to ordering electrified hardware, schedule and hold meeting to coordinate door hardware with security, electrical, doors and frames, and other related suppliers.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site.
- B. Tag each item or package separately with identification coordinated with final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.
1. Deliver each article of hardware in manufacturer's original packaging.
- C. Project Conditions:
1. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.
 2. Provide secure lock-up for door hardware delivered to Project. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.
- D. Protection and Damage:
1. Promptly replace products damaged during shipping.
 2. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work.
 3. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.
- E. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.
- F. Deliver keys to Owner by registered mail or overnight package service.

1.07 COORDINATION

- A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete.
- B. Installation Templates: Distribute for doors, frames, and other work specified to be factory or shop prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.
- D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

1.08 WARRANTY

- A. Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Beginning from date of Substantial Completion, for durations indicated.
 - a. Closers:
 - 1) Mechanical: 25 years.
 - b. Exit Devices:
 - 1) Mechanical: 3 years.
 - 2) Electrified: 1 year.
 - c. Locksets:
 - 1) Mechanical: 10 years.
 - 2) Electrified: 1 year.
 - d. Continuous Hinges: Lifetime warranty.
 - e. Key Blanks: Lifetime
2. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.

1.09 MAINTENANCE

- A. Maintenance Tools: Furnish complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. The Owner requires use of certain products for their unique characteristics and project suitability to insure continuity of existing and future performance and maintenance standards. After investigating available product offerings, the Awarding Authority has elected to prepare proprietary specifications. These products are specified with the notation: "No Substitute."
 1. Where "No Substitute" is noted, submittals and substitution requests for other products will not be considered.
- B. Approval of manufacturers and/or products other than those listed as "Scheduled Manufacturer" or "Acceptable Manufacturers" in the individual article for the product category shall be in accordance with QUALITY ASSURANCE article, herein.
- C. Approval of products from manufacturers indicated in "Acceptable Manufacturers" is contingent upon those products providing all functions and features and meeting all requirements of scheduled manufacturer's product.
- D. Where specified hardware is not adaptable to finished shape or size of members requiring hardware, furnish suitable types having same operation and quality as type specified, subject to Architect's approval.
- E. Products not listed shall submit requests for substitution in accordance with Division 01 25 00 Product Substitution Procedures

2.02 MATERIALS

- A. Fasteners
 1. Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation.
 2. Furnish screws for installation with each hardware item. Finish exposed (exposed under any condition) screws to match hardware finish, or, if exposed in surfaces of other work, to match finish of this other work including prepared for paint surfaces to receive painted finish.
 3. Provide concealed fasteners for hardware units exposed when door is closed except when no standard units of type specified are available with concealed fasteners. Do not use thru-bolts for installation where bolt head or nut on opposite face is exposed in other

- work unless thru-bolts are required to fasten hardware securely. Review door specification and advise Architect if thru-bolts are required.
4. Install hardware with fasteners provided by hardware manufacturer.
- B. Provide screws, bolts, expansion shields, drop plates and other devices necessary for hardware installation.
1. Where fasteners are exposed to view: Finish to match adjacent door hardware material.
- C. Cable and Connectors: Hardwired Electronic Access Control Lockset and Exit Device Trim:
1. Data: 24AWG, 4 conductor shielded, Belden 9843, 9841 or comparable.
 2. DC Power: 18 AWG, 2 conductor, Belden 8760 or comparable.
 3. Provide type of data and DC power cabling required by access control device manufacturer for this installation.
 4. Where scheduled in the hardware sets, provide each item of electrified hardware and wire harnesses with sufficient number and wire gauge with standardized Molex plug connectors to accommodate electric function of specified hardware. Provide Molex connectors that plug directly into connectors from harnesses, electric locking and power transfer devices. Provide through-door wire harness for each electrified locking device installed in a door and wire harness for each electrified hinge, electrified continuous hinge, electrified pivot, and electric power transfer for connection to power supplies.

2.03 HINGES

- A. Manufacturers and Products:
1. Scheduled Manufacturer and Product: Ives 5BB series.
 2. Acceptable Manufacturers and Products: Hager BB series, McKinney TA/T4A series, Stanley FBB Series.
- B. Requirements:
1. Provide hinges conforming to ANSI/BHMA A156.1.
 2. 1-3/4 inch (44 mm) thick doors, up to and including 36 inches (914 mm) wide:
 - a. Exterior: Standard weight, bronze or stainless steel, 4-1/2 inches (114 mm) high
 - b. Interior: Standard weight, steel, 4-1/2 inches (114 mm) high
 3. 1-3/4 inch (44 mm) thick doors over 36 inches (914 mm) wide:
 - a. Exterior: Heavy weight, bronze/stainless steel, 5 inches (127 mm) high
 - b. Interior: Heavy weight, steel, 5 inches (127 mm) high
 4. 2 inches or thicker doors:
 - a. Exterior: Heavy weight, bronze or stainless steel, 5 inches (127 mm) high
 - b. Interior: Heavy weight, steel, 5 inches (127 mm) high
 5. Provide three hinges per door leaf for doors 90 inches (2286 mm) or less in height, and one additional hinge for each 30 inches (762 mm) of additional door height.
 6. Where new hinges are specified for existing doors or existing frames, provide new hinges of identical size to hinge preparation present in existing door or existing frame.
 7. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:
 - a. Steel Hinges: Steel pins
 - b. Non-Ferrous Hinges: Stainless steel pins
 - c. Out-Swinging Exterior Doors: Non-removable pins
 - d. Out-Swinging Interior Lockable Doors: Non-removable pins
 - e. Interior Non-lockable Doors: Non-rising pins
 8. Width of hinges: 4-1/2 inches (114 mm) at 1-3/4 inch (44 mm) thick doors, and 5 inches (127 mm) at 2 inches (51 mm) or thicker doors. Adjust hinge width as required for door, frame, and wall conditions to allow proper degree of opening.
 9. Provide hinges with electrified options as scheduled in the hardware sets. Provide with sufficient number and wire gage to accommodate electric function of specified hardware.

Locate electric hinge at second hinge from bottom or nearest to electrified locking component.

10. Provide mortar guard for each electrified hinge specified.
11. Provide spring hinges where specified. Provide two spring hinges and one bearing hinge per door leaf for doors 90 inches (2286 mm) or less in height. Provide one additional bearing hinge for each 30 inches (762 mm) of additional door height.

2.04 CONTINUOUS HINGES

1. Manufacturers:
 - a. Scheduled Manufacturer: Ives.
 - b. Acceptable Manufacturers: Select, Stanley.
2. Requirements:
 - a. Provide aluminum geared continuous hinges conforming to ANSI/BHMA A156.26, Grade 1.
 - b. Provide aluminum geared continuous hinges, where specified in the hardware sets, fabricated from 6063-T6 aluminum.
 - c. Provide split nylon bearings at each hinge knuckle for quiet, smooth, self-lubricating operation.
 - d. Provide hinges capable of supporting door weights up to 450 pounds, and successfully tested for 1,500,000 cycles.
 - e. On fire-rated doors, provide aluminum geared continuous hinges that are classified for use on rated doors by testing agency acceptable to authority having jurisdiction.
 - f. Provide aluminum geared continuous hinges with electrified option scheduled in the hardware sets. Provide with sufficient number and wire gage to accommodate electric function of specified hardware.
 - g. Install hinges with fasteners supplied by manufacturer.
 - h. Provide hinges 1 inch (25 mm) shorter in length than nominal height of door, unless otherwise noted or door details require shorter length and with symmetrical hole pattern.

2.05 CYLINDRICAL LOCKS – GRADE 1

- A. Manufacturers and Products:
 1. Scheduled Manufacturer and Product: Schlage ND series.
 2. Acceptable Manufacturers and Products: No substitution.
- B. Requirements:
 1. Provide cylindrical locks conforming to ANSI/BHMA A156.2 Series 4000, Grade 1, and UL Listed for 3 hour fire doors.
 2. Cylinders: Refer to “KEYING” article, herein.
 3. Provide locks with standard 2-3/4 inches (70 mm) backset, unless noted otherwise, with 1/2 inch latch throw. Provide proper latch throw for UL listing at pairs.
 4. Provide locksets with separate anti-rotation thru-bolts, and no exposed screws.
 5. Provide independently operating levers with two external return spring cassettes mounted under roses to prevent lever sag.
 6. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
 7. Provide electrified options as scheduled in the hardware sets.
 8. Lever Trim: Solid cast levers without plastic inserts, and wrought roses on both sides.
 - a. Lever Design: Schlage Sparta (SPA)
 - b. Tactile Warning (Knurling): Where required by authority having jurisdiction. Provide on levers on exterior (secure side) of doors serving rooms considered to be hazardous.

2.06 EXIT DEVICES

- A. Manufacturers and Products:
1. Scheduled Manufacturer and Product: Falcon 25 series.
 2. Acceptable Manufacturers and Products: Sargent 19-43-GL-80 series, Corbin Russwin ED5000 series.
- B. Requirements:
1. Provide exit devices tested to ANSI/BHMA A156.3 Grade 1 and UL listed for Panic Exit or Fire Exit Hardware.
 2. Cylinders: Refer to “KEYING” article, herein.
 3. Provide touchpad type exit devices, fabricated of brass, bronze, stainless steel, or aluminum, plated to standard architectural finishes to match balance of door hardware.
 4. Touchpad must extend a minimum of one half of door width. No plastic inserts are allowed in touchpads.
 5. Provide exit devices with deadlatching feature for security and for future addition of alarm kits and/or other electrified requirements.
 6. Provide flush end caps for exit devices.
 7. Provide exit devices with manufacturer’s approved strikes.
 8. Provide exit devices cut to door width and height. Install exit devices at height recommended by exit device manufacturer, allowable by governing building codes, and approved by Architect.
 9. Mount mechanism case flush on face of doors, or provide spacers to fill gaps behind devices. Where glass trim or molding projects off face of door, provide glass bead kits.
 10. Provide cylindrical or hex-key dogging as specified at non fire-rated openings.
 11. Removable Mullions: 2 inches (51 mm) x 3 inches (76 mm) steel tube. Where scheduled as keyed removable mullion, provide type that can be removed by use of a keyed cylinder, which is self-locking when re-installed.
 12. Provide factory drilled weep holes for exit devices used in full exterior application, highly corrosive areas, and where noted in hardware sets.
 13. Provide electrified options as scheduled.
 14. Provide exit devices with optional trim designs to match other lever and pull designs used on the project.
 - a. Tactile Warning (Knurling): Where required by authority having jurisdiction. Provide on levers on exterior (secure side) of doors serving rooms considered to be hazardous.

2.07 ELECTRONIC ACCESS CONTROL LOCKSETS

- A. Manufacturers:
1. Scheduled Manufacturer and Product: Schlage CO Series.
 2. Acceptable Manufacturers and Products: No Substitute.
- B. Product: Schlage CO-100-CY standalone bored-type electronic lockset.
1. Provide bored cylindrical locks conforming to ANSI/BHMA A156.2 Series 4000, Grade 1, non-handed, field-reversible.
 2. Backset: 2-3/4-inch (70 mm)
 3. Latchbolt Throw: 1/2-inch (13 mm) unless noted otherwise. Provide 3/4-inch (19 mm) throw for UL listing at pairs.
 4. Chassis: Standard 161 cylindrical lock prep for 1-3/4-inch (44 mm) doors
- C. Requirements:
1. Provide offline electronic access control products that comply with the following requirements:
 - a. Listed, UL 294 - The Standard of Safety for Access Control System Units.
 - b. Compliant with ANSI/BHMA A156.25 Grade 1 Operation and Security.

- c. Certified to UL10C, FCC Part15, Florida Building Code Standards TAS 201 large missile impact, TAS 202 and TAS 203.
 - d. Compliant with ASTM E330 for door assemblies.
 - e. Compliant with ICC / ANSI A117.1, NFPA 101, NFPA 80, and Industry Canada RSS-210.
- 2. Functions: Provide functions as scheduled that are field configurable without taking the offline electronic product off the door.
- 3. Emergency Override: Provide mechanical key override; cylinders: Refer to “KEYING” article, herein.
- 4. Levers:
 - a. Vandal Resistance: Exterior (secure side) lever rotates freely while door remains locked, preventing damage to internal lock components from vandalism by excessive force.
 - b. Provide non-handed lever trim that operates independently of non-locking levers.
 - c. Style: Schlage Sparta (SPA)
 - d. Tactile Warning (Knurling): Where required by authority having jurisdiction. Provide on levers on exterior (secure side) of doors serving rooms considered to be hazardous.
- 5. Power Supply: 4 AA batteries
 - a. Provide electronic access control locks and/or exit device trim with the ability to communicate battery status.
- 6. Features:
 - a. Visual tri-colored LED indicators that indicate activation, operational systems status, system error conditions and low power conditions.
 - b. Visual bi-colored LED indicator on interior that is capable of indicating secured/unsecured status of device to occupants on interior.
 - c. Audible feedback that can be enabled or disabled.
 - d. Onboard processor with memory capacity of 2,000 users, 2,000 event audit history, up to 16 time zones and up to 32 calendar events.
 - e. Tamper-Resistant Screws: Tamper torx screws on inside escutcheon for increased security.
- 7. Switches:
 - a. Mechanical Key Override
- 8. Credential Reader:
 - a. Credential Reader Capabilities: Provide credential readers capable of operating with the following integrated software partners.
 - 1) Magnetic card triple track reader capable of reading tracks 1, 2 or 3 per configuration in field.
 - 2) Swipe reader capable of reading information along full length of magnetic stripe.
 - 3) 125 kHz Proximity card or fob credentials: Schlage, XceedID, HID, GE/CASI ProxLite and AWID.
 - 4) Dual credential reader with keypad plus proximity reader capable of reading card or fob.
 - 5) 125 kHz Proximity card credentials: Schlage, XceedID, HID, GE/CASI ProxLite and AWID.
 - 6) 12 button keypad with backlit buttons.
- 9. Operation:
 - a. Provide electronic access control locks and/or exit device trim with the ability to be configured at door by handheld programming device the length of time device is unlocked upon access grant.

- b. Provide electronic access control locks and/or exit device trim with the ability to communicate identifying information such as firmware versions, hardware versions, serial numbers, and manufacturing dates by handheld programming device.

2.08 CYLINDERS

- A. Manufacturers and Products:
 - 1. Scheduled Manufacturer: Schlage
 - 2. Acceptable Manufacturers and Products: No substitution.
- B. Requirements:
 - 1. Provide cylinders/cores, from the same manufacturer of locksets, compliant with ANSI/BHMA A156.5; latest revision; cylinder face finished to match lockset, manufacturer's series as indicated. Refer to "KEYING" article, herein.
 - 2. Provide cylinders in the below-listed configuration(s), distributed throughout the Project as indicated.
 - a. Conventional Open: cylinder with full size interchangeable core (FSIC) core with open keyway
- C. Construction Keying:
 - 1. Replaceable Construction Cores.
 - a. Provide temporary construction cores replaceable by permanent cores, furnished in accordance with the following requirements.
 - 1) 3 construction control keys
 - 2) 12 construction change (day) keys.
 - b. Owner or Owner's Representative will replace temporary construction cores with permanent cores.

2.09 KEYING

- A. Provide a factory registered keying system, complying with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.
- B. Comply with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.
- C. Provide cylinders/cores managed by Owner's locksmith, complying with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference. Contact:
 - 1. Firm Name:
 - 2. Contact Person:
 - 3. Telephone:
- D. Requirements:
 - 1. Provide permanent cylinders/cores keyed by the manufacturer according to the following key system.
 - a. Master Keying system as directed by the Owner.
 - 2. Forward bitting list and keys separately from cylinders, by means as directed by Owner. Failure to comply with forwarding requirements will be cause for replacement of cylinders/cores involved at no additional cost to Owner.
 - 3. Provide keys with the following features:
 - a. Material: Nickel silver; minimum thickness of .107-inch (2.3mm)
 - 4. Identification:
 - a. Mark permanent cylinders/cores and keys with applicable blind code per DHI publication "Keying Systems and Nomenclature" for identification. Do not provide blind code marks with actual key cuts.
 - b. Identification stamping provisions must be approved by the Architect and Owner.

- c. Stamp cylinders/cores and keys with Owner's unique key system facility code as established by the manufacturer; key symbol and embossed or stamped with "DO NOT DUPLICATE" along with the "PATENTED" or patent number to enforce the patent protection.
- d. Failure to comply with stamping requirements will be cause for replacement of keys involved at no additional cost to Owner.
- e. Forward permanent cylinders/cores to Owner, separately from keys, by means as directed by Owner.
- 5. Quantity: Furnish in the following quantities.
 - a. Change (Day) Keys: 3 per cylinder/core.
 - b. Permanent Control Keys: 3.
 - c. Master Keys: 6.

2.10 KEY CONTROL SYSTEM

- A. Manufacturers:
 - 1. Scheduled Manufacturer: Telkee.
 - 2. Acceptable Manufacturers: HPC, Lund.
- B. Requirements:
 - 1. Provide key control system, including envelopes, labels, tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet, all as recommended by system manufacturer, with capacity for 150% of number of locks required for Project.
 - a. Provide complete cross index system set up by hardware supplier, and place keys on markers and hooks in cabinet as determined by final key schedule.
 - b. Provide hinged-panel type cabinet for wall mounting.

2.11 PROTECTION PLATES

- A. Manufacturers:
 - 1. Scheduled Manufacturer: Ives.
 - 2. Acceptable Manufacturers: Burns, Rockwood.
- B. Requirements:
 - 1. Provide kick plates, mop plates, and armor plates minimum of 0.050 inch (1 mm) thick, beveled four edges as scheduled. Furnish with sheet metal or wood screws, finished to match plates.
 - 2. Sizes of plates:
 - a. Kick Plates: 10 inches (254 mm) high by 2 inches (51 mm) less width of door on single doors, 1 inch (25 mm) less width of door on pairs
 - b. Mop Plates: 4 inches (102 mm) high by 2 inches (51 mm) less width of door on single doors, 1 inch (25 mm) less width of door on pairs
 - c. Armor Plates: 36 inches (914 mm) high by 2 inches (51 mm) less width of door on single doors, 1 inch (25 mm) less width of door on pairs

2.12 OVERHEAD STOPS AND OVERHEAD STOP/HOLDERS

- A. Manufacturers:
 - 1. Scheduled Manufacturers: Glynn-Johnson.
 - 2. Acceptable Manufacturers: Rixson, Sargent.
- B. Requirements:
 - 1. Provide heavy duty concealed mounted overhead stop or holder as specified for exterior and interior vestibule single acting doors.

2. Provide heavy duty concealed mounted overhead stop or holder as specified for double acting doors.
3. Provide heavy or medium duty and concealed or surface mounted overhead stop or holder for interior doors as specified. Provide medium duty surface mounted overhead stop for interior doors and at any door that swings more than 140 degrees before striking wall, open against equipment, casework, sidelights, and where conditions do not allow wall stop or floor stop presents tripping hazard.
4. Where overhead holders are specified provide friction type at doors without closer and positive type at doors with closer.

2.13 FINISHES

- A. Finish: BHMA 626/652 (US26D); except:
 1. Hinges at Exterior Doors: BHMA 630 (US32D)
 2. Continuous Hinges: BHMA 630 (US32D)
 3. Continuous Hinges: BHMA 628 (US28)
 4. Push Plates, Pulls, and Push Bars: BHMA 630 (US32D)
 5. Protection Plates: BHMA 630 (US32D)
 6. Overhead Stops and Holders: BHMA 630 (US32D)
 7. Door Closers: Powder Coat to Match
 8. Wall Stops: BHMA 630 (US32D)
 9. Latch Protectors: BHMA 630 (US32D)

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Prior to installation of hardware, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Field verify existing doors and frames receiving new hardware and existing conditions receiving new openings. Verify that new hardware is compatible with existing door and frame preparation and existing conditions.
- C. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Mount door hardware units at heights to comply with the following, unless otherwise indicated or required to comply with governing regulations.
 1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
 2. Custom Steel Doors and Frames: HMMA 831.
 3. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
- B. Install each hardware item in compliance with manufacturer's instructions and recommendations, using only fasteners provided by manufacturer.
- C. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.
- D. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.

- E. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- F. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.
- G. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated or one hinge for every **30 inches (750 mm)** of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.
- H. Intermediate Offset Pivots: Where offset pivots are indicated, provide intermediate offset pivots in quantities indicated in door hardware schedule but not fewer than one intermediate offset pivot per door and one additional intermediate offset pivot for every **30 inches (750 mm)** of door height greater than **90 inches (2286 mm)**.
- I. Lock Cylinders: Install construction cores to secure building and areas during construction period.
- J. Replace construction cores with permanent cores as indicated in keying section.
- K. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.
- L. Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings or in equipment room, or alternate location as directed by Architect.
- M. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

3.03 FIELD QUALITY CONTROL

- A. Engage qualified manufacturer trained representative to perform inspections and to prepare inspection reports.
 - 1. Representative will inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.

3.04 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
 - 1. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
- B. Occupancy Adjustment: Approximately three to six months after date of Substantial Completion, Installer's Architectural Hardware Consultant must examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors and door hardware.

3.05 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items as necessary to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

3.06 DOOR HARDWARE SCHEDULE

- A. Hardware items are referenced in the following hardware. Refer to the above-specifications for special features, options, cylinders/keying, and other requirements.
- B. Hardware Sets:

Hardware Group No. GK715 (PEDESTRIAN GATE)

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	SET	GATE HINGE/CLOSURE	BY GATE MANUFACTURER	626	B/O
1	EA	PANIC HARDWARE	LD-25-R-EO (DRILL 3 HOLES AT BOTTOM OF DEVICES TO ALLOW FOR MOISTURE TO DRAIN)	626	FAL
1	EA	ELEC EXIT DEVICE TRIM	CO-100-993R-70-KP-RHO-J 4B BATTERY OPERATED	626	SCE
1	EA	FISC CORE	23-030	626	SCH
1	EA	FISC CONST. CORE	23-030 ICX	622	SCH

-HARDWARE SET IS A GUIDE LINE; GENERAL CONTRACTOR SHOULD CONDUCT A COORDINATION MEETING WITH THE GATE FABRICATOR AND HARDWARE SUPPLIER BEFORE EITHER THE GATE IS FABRICATED OR THE HARDWARE ORDERED.

-PROVIDE MOUNTING ACCESSORIES TO MOUNT HARDWARE TO GATE.

OPERATIONAL DESCRIPTION: DOOR NORMALLY CLOSED AND LOCKED. ENTRY BY VALID KEYPAD CREDENTIAL OR MANUAL KEY OVERRIDE. FREE EGRESS AT ALL TIME.

END OF SECTION

SECTION 09 91 00 - PAINTING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. General Coordination Procedures, (Reference Specification Section 01 31 00) General Contractor shall coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work that depend on each other for proper installation, connection, and operation.

1.02 SUMMARY

- A. Provide complete surface preparation, priming, field painting and sealing of exposed exterior and interior items and surfaces.
 - 1. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.
 - 2. Examine specifications for various other trades and their provisions regarding their painting. Surfaces that are left unfinished by other sections of specifications shall be painted or finished as a part of this section.
- B. Paint exposed surfaces, except where these Specifications indicate that the surface or material is not to be painted or is to remain natural. If an item or a surface is not specifically mentioned, paint the item or surface the same as similar adjacent materials or surfaces. If a color of finish is not indicated, Architect will select from standard colors and finishes available.
 - 1. Painting includes field painting of exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron supports, and surfaces of mechanical and electrical equipment that do not have a factory-applied final finish.
- C. Do not paint prefinished items and finished metal surfaces except where otherwise noted in Drawings or specifications. Do not paint concealed surfaces, operating parts, and labels.
 - 1. Prefinished items include the following factory-finished components:
 - a. Architectural woodwork.
 - b. Acoustical wall panels.
 - c. Toilet enclosures.
 - d. Metal lockers.
 - e. Elevator entrance doors and frames.
 - f. Elevator equipment.
 - g. Finished mechanical and electrical equipment.
 - h. Light fixtures.
 - i. Wood Ceiling Panels
 - j. Prefinished wall, roof & soffit panels
 - k. Apparatus Bay Doors
 - 2. Concealed surfaces include walls or ceilings in the following generally inaccessible spaces:
 - a. Foundation spaces.
 - b. Furred areas.
 - c. Ceiling plenums.
 - d. Pipe spaces.
 - e. Duct shafts.
 - f. Elevator shafts.

3. Finished metal surfaces include the following:
 - a. Anodized aluminum.
 - b. Stainless steel.
 - c. Chromium plate.
 - d. Copper and copper alloys.
 - e. Bronze and brass.
 4. Operating parts include moving parts of operating equipment and the following:
 - a. Valve and damper operators.
 - b. Linkages.
 - c. Sensing devices.
 - d. Motor and fan shafts.
 5. Labels: Do not paint over UL, FMG, or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.
- D. Related Sections include the following:
1. Division 5 Section "Structural Steel" for shop priming structural steel.
 2. Division 5 Section "Metal Fabrications" for shop priming ferrous metal.
 3. Division 6 Section "Architectural Woodwork" for shop priming interior architectural woodwork.
 4. Division 7 Section "Joint Sealers ".
 5. Division 8 Section "Wood Doors ".
 6. Division 8 Section "Steel Doors and Frames" for factory priming steel doors and frames.
 7. Division 8 Section "Wood Window & Door Restoration".
 8. Division 9 Section "Plaster ".
 9. Division 9 Section "Gypsum Board" for surface preparation of gypsum board.
 10. Division 32 Section "Pavement Accessories" for traffic-marking paint.

1.03 DEFINITIONS

- A. General: Standard coating terms defined in ASTM D 16 apply to this Section.
1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85-degree meter.
 2. Eggshell refers to low-sheen finish with a gloss range between 20 and 35 when measured at a 60-degree meter.
 3. Semigloss refers to medium-sheen finish with a gloss range between 35 and 70 when measured at a 60-degree meter.
 4. Full gloss refers to high-sheen finish with a gloss range more than 70 when measured at a 60-degree meter.

1.04 SUBMITTALS

- A. Product Data: For each paint system indicated. Include block fillers and primers.
1. Material List: An inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
 2. Manufacturer's Information: Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material.
- B. Samples for Verification: For each color and material to be applied, with texture to simulate actual conditions, on representative Samples of the actual substrate.
1. Provide stepped Samples, defining each separate coat, including block fillers and primers. Use representative colors when preparing Samples for review. Resubmit until required sheen, color, and texture are achieved.
 2. Provide a list of materials and applications for each coat of each Sample. Label each Sample for location and application.

3. Submit 3 samples on the following substrates for Architect's review of color and texture only:
 - a. Painted Gypsum Board: 8-inch-square samples for each color and material on hardboard.
 - b. Stained or Natural Wood: 6-by-10-inch samples of natural- or stained-wood finish on representative Medium Red Oak surfaces.
 - c. Ferrous Metal: 4-inch-square samples of flat metal and 8-inch-long Samples of solid metal for each color and finish. (Field installation acceptable).
- C. Qualification Data: For Applicator.
- D. The Contractor shall furnish the Owner with a booklet of actual samples of the colors used on the project at project completion.

1.05 QUALITY ASSURANCE

- A. Applicator Qualifications: A firm or individual experienced in applying paints and coatings similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.
- B. Source Limitations: Obtain block fillers and primers for each coating system from the same manufacturer as the finish coats.
- C. Benchmark Samples (Mockups): Provide a full-coat benchmark finish sample for each type of coating and substrate required. Comply with procedures specified in PDCA P5. Duplicate finish of approved sample Submittals.
 1. Architect will select one room or surface to represent surfaces and conditions for application of each type of coating and substrate.
 - a. Wall Surfaces: Provide samples on at least 100 sq. ft.
 - b. Small Areas and Items: Architect will designate items or areas required.
 - c. Portion of all wood to be finished or restored, including windows, doors, frames, rails, etc.
 2. Apply benchmark samples, according to requirements for the completed Work, after permanent lighting and other environmental services have been activated. Provide required sheen, color, and texture on each surface.
 - a. After finishes are accepted, Architect will use the room or surface to evaluate coating systems of a similar nature.
 3. Final approval of colors will be from benchmark samples.
- D. Wood Sealer: Shall meet Fed. Spec. TT-W-572B for water repellence.
- E. Materials shall be manufacturer's best grade of respective paint types.
- F. Gloss levels for paints required are as per the National Paint and Coatings Association.
- G. Prior to acid-etching of the concrete floor and application of the epoxy coating, an on-site conference of the applicator, contractor, Architect and manufacturer's representative shall review proper installation procedures.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:
 1. Product name or title of material.
 2. Product description (generic classification or binder type).
 3. Manufacturer's stock number and date of manufacture.
 4. Contents by volume, for pigment and vehicle constituents.
 5. Thinning instructions.
 6. Application instructions.

7. Color name and number.
 8. VOC content.
- B. Store materials not in use in tightly covered containers in a well-ventilated area at an ambient temperature between 45 and 95 deg F. Maintain storage containers in a clean condition, free of foreign materials and residue.
1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily.

1.07 PROJECT CONDITIONS

- A. Apply waterborne paints only when temperatures of surfaces to be painted and surrounding air are between 50 and 90 deg F.
- B. Apply solvent-thinned paints only when temperatures of surfaces to be painted and surrounding air are between 45 and 95 deg F.
- C. Do not apply paint in snow, rain, fog, or mist; or when relative humidity exceeds 85 percent; or at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.
1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.
- D. Provide adequate ventilation of spaces while applying primer and finish coats.
- E. All application of coatings shall be done under adequate illumination.

1.08 EXTRA MATERIALS

- A. Furnish extra paint materials from the same production run as the materials applied and in the quantities described below. Package with protective covering for storage and identify with labels describing contents. Deliver extra materials to Owner.
1. Quantity: Furnish Owner with an additional 3 percent, but not less than 1 gal. or 1 case, as appropriate, of each material and color applied.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in other Part 2 articles.
- B. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles.
- C. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
1. Sherwin-Williams Co. (Sherwin-Williams).

2.02 PAINT MATERIALS, GENERAL

- A. Material Compatibility: Provide block fillers, primers, and finish-coat materials that are compatible with one another and with the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
- B. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint-material containers not displaying manufacturer's product identification will not be acceptable.

1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.

C. Colors: As indicated on drawings.

2.03 CONCRETE UNIT MASONRY BLOCK FILLERS

- A. Concrete Unit Masonry Block Filler: Factory-formulated high-performance latex block fillers.
1. Sherwin-Williams; PrepRite Interior/Exterior Block Filler B25W25: Applied at a dry film thickness of not less than 8.0 mils.

2.04 EXTERIOR PRIMERS

- A. Exterior Ferrous-Metal Primer: Factory-formulated rust-inhibitive metal primer for exterior application.
1. Sherwin-Williams; Pro-Cryl Universal Primer B66-310 Series: Applied at a dry film thickness of not less than 3.0 mils.
- B. Exterior Galvanized Metal Primer: Factory-formulated galvanized metal primer for exterior application.
1. Sherwin-Williams; Pro-Cryl Universal Primer B66-310 Series: Applied at a dry film thickness of not less than 3.0 mils.
- C. Exterior Primer for existing ceramic coated sheet metal: Sherwin-Williams B51- 450 Interior/Exterior Multi-Purpose Latex "Adhesion Primer", or approved equal. Applied at a dry film thickness of 1.4 mils.
1. Adhesion Primer must be topcoated within 14 days of primer application.
- D. Exterior Primer for Concrete and Fiber Cement Siding (Hardi Board): Loxon Concrete & Masonry Primer B24W8300: Applied at a dry film thickness of not less than 3.0 mils.
- E. Exterior Primer for Drywall: Sherwin-Williams B51- 450 Interior/Exterior Multi-Purpose Latex "Adhesion Primer", or approved equal. Applied at a dry film thickness of 1.4 mils.
- F. Exterior Architectural PVC, Plastic, or Fiberglass: Sherwin-Williams B51- 450 Interior/Exterior Multi-Purpose Latex "Adhesion Primer", or approved equal. Applied at a dry film thickness of 1.4 mils.

2.05 INTERIOR PRIMERS

- A. Interior Concrete Primer: Factory-formulated alkali-resistant acrylic-latex interior primer for interior application.
1. Sherwin-Williams; Loxon Concrete & Masonry Primer B24W8300: Applied at a dry film thickness of not less than 3.0 mils.
- B. Interior Masonry Primer: 100% acrylic-emulsion conditioner for interior application only, to bond light chalk to the surface of existing brick & CMU.
1. Sherwin-Williams; Loxon Conditioner Masonry Primer A24-1100 Series: Applied at a dry film thickness per manufacturer's recommendation.
 2. No substitutions
- C. Interior Gypsum Board Primer: Factory-formulated latex-based primer for interior application.
1. Sherwin-Williams; ProMar 200 Zero VOC Latex Wall Primer B28W2600 Series: Applied at a dry film thickness of not less than 1.5 mils.

- D. Interior Wood Primer for Full-Gloss Alkyd-Enamel Finishes: Factory-formulated alkyd- or acrylic-latex-based interior wood primer.
 - 1. Sherwin-Williams; Premium Wall and Wood Interior Latex Primer B28W8111 Series: Applied at a dry film thickness of not less than 1.8 mils.
- E. Interior Ferrous-Metal Primer: Factory-formulated quick-drying rust-inhibitive alkyd-based metal primer.
 - 1. Sherwin-Williams; Pro-Cryl Universal Primer B66-310 Series: Applied at a dry film thickness of not less than 3.0 mils.
- F. Interior Zinc-Coated Metal Primer: Factory-formulated galvanized metal primer.
 - 1. Sherwin-Williams; Pro-Cryl Universal Primer B66-310 Series: Applied at a dry film thickness of not less than 3.0 mils.

2.06 EXTERIOR FINISH COATS

- A. Exterior Semi-Gloss Acrylic Enamel for Ferrous and Other Metals: (Lintels, Trim): Factory-formulated semi-gloss waterborne acrylic-latex enamel for exterior application.
 - 1. Sherwin-Williams; Pro Industrial Acrylic Semi-Gloss B66-650 Series: Applied at a dry film thickness of not less than 2.5 mils.
- B. Exterior Wood, Cement, or Brick Satin Finish: Sherwin-Williams A-100 Exterior Latex Satin, A82-100 Series. Applied at a dry film thickness of not less than 1.5 mils.
- C. Exterior Textured Coating: Sherwin-Williams Ultra Crete Medium Textured Coating, A44W811. Applied at 50-80 sq. ft/gal.
- D. Exterior Metal Canopy Semi-Gloss Sherwin-Williams SprayLastic Exterior Semi-Gloss Waterborne Dryfall, B42W17/B42T17. Applied at a dry film thickness of not less than 2.0 mils.
- E. Exterior Stained Wood Semi-Transparent: Sherwin-Williams WoodScapes Exterior Polyurethane Semi-Transparent Stain, A15T5.

2.07 INTERIOR FINISH COATS

- A. Interior Flat Acrylic Paint: Factory-formulated flat acrylic-emulsion latex paint for interior application: ProMar 200 Zero VOC Interior Latex Flat. Applied to a dry film thickness of not less than 1.6 mils.
- B. Interior Low-Luster Acrylic Enamel: Factory-formulated eggshell acrylic-latex interior enamel: Promar 200 Zero VOC Interior Eg-Shel. Applied to a dry film thickness of not less than 1.7 mils.
- C. Interior Full-Gloss Alkyd Enamel for Wood and Metal Surfaces: Factory-formulated full-gloss alkyd interior enamel.
 - 1. Sherwin-Williams; ProMar 200 Alkyd Gloss Enamel B35-200 Series: Applied at a dry film thickness of not less than 1.5 mils.
- D. Interior Full Gloss Epoxy:
 - 1. Sherwin-Williams; Tile-Clad High Solids Epoxy B62Z series: Applied at a dry film thickness of not less than 2.5 mils.
- E. Interior Precatalysed Water-Based Epoxy:
 - 1. Sherwin-Williams; Pro Industrial Pre-Catalysed Water-based Epoxy K45-150 Series (Egg-shell): Applied at a dry film thickness of not less than 1.5 mils.
- F. Interior DryFall, Water Based Flat, for Galvanized Steel Decking: Sherwin-Williams Pro Industrial Waterborne Acrylic Dryfall B42W81.

2.08 INTERIOR WOOD STAINS AND VARNISHES

- A. Interior Stain: Refer to Division 06 "Interior Architectural Woodwork" and drawings for stain color.

2.09 MISCELLANEOUS PAINT PRODUCTS

- A. Epoxy: Two component epoxy coating shall be Sherwin-William's "Tile-Clad High Solids Epoxy #B62Z Series, or approved equal.
- B. Semi-transparent water repellent wood preservative stain shall be Olympic's Semi-Transparent Oil Base Stain, or equal.
- C. Other materials such as linseed oil, turpentine and shellacs shall be pure and of highest quality.
- D. Acrylic Concrete Coating: Exterior concrete coating shall be "Thorocoat" 100% acrylic, textured coating as manufactured by Thoro System Products, Miami, Florida. Color as selected by Architect.
- E. Concrete Floor Sealer: Exposed concrete floor slabs with smooth troweled finish: One coat flood-applied, hardener/densifier. Chemical reactive silicate / silicate formulation that enhances sheen level of troweled concrete and is designed to maintain or increase sheen level over time with normal wear. Provide one of the following or approved equal product by another Manufacturer:
 - a. Euclid Chemical Company; "Euco Diamond Hard", www.euclidchemical.com.
 - b. CureCrete Chemical Company; "Ashford Formula", www.ashfordformula.com.
 - c. Dayton Superior; "Sure-Hard Densifier J17", www.daytonchemical.com.
 - d. L&M Construction Chemicals; "Seal Hard", www.lmmc.com.
- F. Epoxy Coating: Interior concrete block to receive coating shall be filled using a modified epoxy masonry filler equal to Tnemec's No. 54-660 and receive epoxy-polyamide coating equal to Tnemec's Series 66 HiBuild Epoxoline.
- G. Waterbased Epoxy: Catalyzed epoxy meeting requirements of ASTM D3730, equal to Sherwin Williams B67 Series.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for paint application.
 - 1. Proceed with paint application only after unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.
 - 2. Start of painting will be construed as Applicator's acceptance of surfaces and conditions within a particular area.
- B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.
 - 1. Notify Architect about anticipated problems when using the materials specified over substrates primed by others.

3.02 PREPARATION

- A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of size or weight of the item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.
- B. Cleaning: Before applying paint or other surface treatments, clean substrates of substances that could impair bond of the various coatings. Remove oil and grease before cleaning.
 1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.
- C. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.
 1. Provide barrier coats over incompatible primers, or remove and re-prime.
 2. Cementitious and Masonry Materials: Prepare brick, concrete, concrete unit masonry, cement plaster, and mineral-fiber-reinforced cement panel surfaces to be painted. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.
 - a. Use abrasive blast-cleaning methods if recommended by paint manufacturer.
 - b. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not paint surfaces if moisture content exceeds that permitted in manufacturer's written instructions.
 3. Wood: Clean new or existing surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand surfaces exposed to view down to consistent substrate for intended finish. Ensure smooth surface remains and remove all residual dust.
 - a. Scrape and clean small, dry, seasoned knots, and apply a thin coat of white shellac or other recommended knot sealer before applying primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.
 - b. Prime, stain, or seal wood to be painted immediately on delivery. Prime edges, ends, faces, undersides, and back sides of wood, including cabinets, counters, trim, rails, doors, frames and windows.
 - c. If transparent finish is required, backprime with spar varnish.
 - d. Seal tops, bottoms, and cutouts of unprimed wood doors with a heavy coat of varnish or sealer immediately on delivery.
 4. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with SSPC's recommendations.
 - a. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
 - b. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with same primer as the shop coat.
 5. Galvanized Surfaces: Clean galvanized surfaces with nonpetroleum-based solvents so surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.
- D. Material Preparation: Mix and prepare paint materials according to manufacturer's written instructions.
 1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
 2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.

3. Use only thinners approved by paint manufacturer and only within recommended limits.
- E. Concrete floor surfaces to remain exposed shall be cleaned and properly acid etched per floor sealer manufacturer's instructions. Fill and patch holes, crevices, cracks, etc.. Remove any paint, soil, loose material and dust. Remove oil or grease with a hot TSP solution and rinse thoroughly. Floor to be completely dry prior to etching with muriatic acid and water solution.

3.03 APPLICATION

- A. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.
 1. Paint colors, surface treatments, and finishes are indicated in the paint schedules.
 2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
 3. Provide finish coats that are compatible with primers used.
 4. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, grilles, convector covers, covers for finned-tube radiation, and similar components are in place. Extend coatings in these areas, as required, to maintain system integrity and provide desired protection.
 5. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 6. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
 7. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
 8. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
 9. Finish interior of wall and base cabinets and similar field-finished casework to match exterior.
 10. Sand lightly between each succeeding enamel or varnish coat.
- B. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
 1. The number of coats and film thickness required are the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
 2. Omit primer over metal surfaces that have been shop primed and touchup painted.
 3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure that edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
 4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, and does not deform or feel sticky under moderate thumb pressure, and until application of another coat of paint does not cause undercoat to lift or lose adhesion.
- C. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.
 1. Brushes: Use brushes best suited for type of material applied. Use brush of appropriate size for surface or item being painted.
 2. Rollers: Use rollers of carpet, velvet-back, or high-pile sheep's wool as recommended by manufacturer for material and texture required.

3. Spray Equipment: Use airless spray equipment with orifice size as recommended by manufacturer for material and texture required.
- D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate to achieve dry film thickness indicated. Provide total dry film thickness of the entire system as recommended by manufacturer.
- E. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in equipment rooms and occupied spaces.
- F. Mechanical items to be painted include, but are not limited to, the following:
 1. Uninsulated metal piping.
 2. Uninsulated plastic piping.
 3. Pipe hangers and supports.
 4. Tanks that do not have factory-applied final finishes.
 5. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
 6. Duct, equipment, and pipe insulation having "all-service jacket" or other paintable jacket material.
 7. Mechanical equipment that is indicated to have a factory-primed finish for field painting.
 8. New rooftop gas piping.
 9. All existing and new exterior conduit, gas, water and similar piping at face of exterior walls.
- G. Block Fillers: Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores filled.
- H. Prime Coats: Before applying finish coats, apply a prime coat, as recommended by manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn-through or other defects due to insufficient sealing.
- I. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.
- J. Transparent (Clear) Finishes: Use multiple coats to produce a glass-smooth surface film of even luster. Provide a finish free of laps, runs, cloudiness, color irregularity, brush marks, orange peel, nail holes, or other surface imperfections.
 1. Provide satin finish for final coats.
- K. Stipple Enamel Finish: Roll and redistribute paint to an even and fine texture. Leave no evidence of rolling, such as laps, irregularity in texture, skid marks, or other surface imperfections.
- L. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

3.04 CLEANING

- A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from Project site.
 1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping without scratching or damaging adjacent finished surfaces.

3.05 PROTECTION

- A. Protect work of other trades, whether being painted or not, against damage from painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Architect.
- B. Provide "Wet Paint" signs to protect newly painted finishes. After completing painting operations, remove temporary protective wrappings provided by others to protect their work.
 - 1. After work of other trades is complete, touch up and restore damaged or defaced painted surfaces prior to final inspection. Comply with procedures specified in PDCA-P1.

3.06 EXTERIOR PAINT SCHEDULE

- A. Ferrous Metal: Provide the following finish systems over exterior ferrous metal. Primer is not required on shop-primed items.
 - 1. Full-Gloss Acrylic-Enamel Finish: Two finish coats over a rust-inhibitive primer.
 - a. Primer: Exterior ferrous-metal primer.
 - b. Finish Coats: Exterior full-gloss acrylic enamel for ferrous and other metals.
- B. Zinc-Coated Metal: Provide the following finish systems over exterior zinc-coated metal surfaces:
 - 1. Full-Gloss Acrylic-Enamel Finish: Two finish coats over a galvanized metal primer.
 - a. Primer: Exterior galvanized metal primer.
 - b. Finish Coats: Exterior full-gloss acrylic enamel for ferrous and other metals.
- C. Cement Fiber Board: Provide the following paint finish systems over cement fiber board surfaces:
 - 1. Latex Satin Finish: Two finish coats over primer.
 - a. Primer: Loxon concrete primer.
 - b. Finish Coats: latex satin finish.

3.07 INTERIOR PAINT SCHEDULE

- A. Concrete Unit Masonry: Provide the following finish systems over new interior concrete masonry:
 - 1. Semigloss Acrylic-Enamel Finish: Two finish coats over a block filler.
 - a. Block Filler: Concrete unit masonry block filler.
 - b. Finish Coats: Interior semigloss acrylic enamel.
- B. Gypsum Board: Provide the following finish systems over interior gypsum board surfaces:
 - 1. Semigloss Acrylic-Enamel Finish: (typical) Two finish coats over a primer.
 - a. Primer: Interior gypsum board primer.
 - b. Finish Coats: Interior semigloss acrylic enamel.
- C. Wood and Hardboard: Provide the following paint finish systems over interior wood surfaces:
 - 1. Semi-Gloss Alkyd-Enamel Finish: Two finish coats over a wood primer.
 - a. Primer: Interior wood primer for semi-gloss alkyd-enamel finishes.
 - b. Finish Coats: Interior Semi-gloss alkyd enamel for wood and metal surfaces.
- D. Ferrous Metal: Provide the following finish systems over ferrous metal:
 - 1. Full-Gloss Acrylic-Enamel Finish: Two finish coats over a primer.
 - a. Primer: Interior ferrous-metal primer.
 - b. Finish Coats: Interior full-gloss acrylic enamel.
- E. Zinc-Coated Metal: Provide the following finish systems over interior zinc-coated metal surfaces:
 - 1. Full-Gloss Acrylic-Enamel Finish: Two finish coats over a primer.
 - a. Primer: Interior zinc-coated metal primer.
 - b. Finish Coats: Interior full-gloss acrylic enamel.

- F. All-Service Jacket over Insulation: Provide the following finish system on cotton or canvas insulation covering:
 - 1. Flat Acrylic Finish: Two finish coats. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coats: Interior flat latex-emulsion size.
- G. Interior Concrete Floors: Provide the following:
 - 1. 1st coat - Sealer / Reducer (400 SF/gal.)
 - 2. 2nd coat - Sealer / Reducer (600 SF/gal.)
 - a. Exposed Concrete Finished Floors.

3.08 INTERIOR STAIN AND NATURAL-FINISH WOODWORK SCHEDULE

- A. Natural-Finish Woodwork: Provide the following natural finishes over new interior woodwork not specified as shop finished:
 - 1. Water Acrylic Finish: Two finish coats over a sanding sealer. Provide wood filler on open-grain wood before applying first varnish coat.
 - a. Sealer Coat: Clear sanding sealer.
 - b. Finish Coats: Acrylic finish clear satin varnish.

END OF SECTION 09 91 00

SECTION 09 96 53 - ELASTOMERIC COATINGS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. General Coordination Procedures, (Reference Specification Section 01 31 00) General Contractor shall coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work that depend on each other for proper installation, connection, and operation.

1.02 SUMMARY

- A. Section Includes:
 - 1. Furnish all labor, materials, tools and equipment as necessary to perform patching and repairs as required, and elastomeric coating installation at existing exterior wall surfaces, as shown on drawings and as specified herein.
- B. Related Sections include the following:
 - 1. Division 09 Section: Painting

1.03 SUBMITTALS

- A. Submit intent to warranty document from manufacturer of elastomeric coating with a performance guarantee against water penetration through film for 5 years with any necessary replacement material and labor supplied at no cost to Owner.
- B. Submit laboratory tests or data that validate product compliance with performance criteria specified.

1.04 QUALITY ASSURANCE

- A. Manufacturer qualifications: Company regularly engaged in manufacturing and marketing of products specified in this section.
- B. Contractor qualifications: Qualified to perform work specified by reason of experience or training provided by product manufacturer.
- C. Notify manufacturer's authorized representative at least two weeks before start of work. Schedule a minimum of 3 job site inspections by manufacturer's authorized representative, first scheduled before application of product. Application of elastomeric coating without prior notice will not constitute acceptance by manufacturer of five-year waterproofing inspection and guarantee procedure.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products in original factory packaging bearing identification of product, manufacturer, batch number, and expiration date as applicable. Provide Material Safety Data Sheets for each product.
- B. Store product in a location protected from freezing, damage, construction activity, precipitation and direct sunlight in strict accordance with manufacturer's recommendations.
- C. Condition products to approximately 60 to 70 degrees F for use in accordance with manufacturer's recommendations.

- D. Handle all products with appropriate precautions and care as stated on Material Safety Data Sheet.
- E. Protect all adjacent work from contamination due to mixing, handling, and application of polymer modified product.

1.06 PROJECT CONDITIONS

- A. Do not use products under conditions of precipitation or freezing weather. Use appropriate measures for protection and supplementary heating to ensure proper drying and curing conditions in accordance with manufacturer's recommendations if application during inclement weather occurs.
- B. Ensure substrate is dry.
- C. Protect all adjacent work from contamination due to mixing, handling, and application of preparation and repair products and elastomeric coating.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. SONNEBORN BUILDING PRODUCTS, BASF Corporation, Shakopee, Minnesota (800) 433-9517, or approved equal.
- B. Use Single Manufacturer's in all other instances and applications as recommended by manufacturer pertaining to this work to provide Owner with a single source system and warranty.
- C. Substitutions - Alternates to acceptable manufacturer will be considered only on basis of written requests and shall include substantiation of product performance as listed in section 2.02 below.

2.02 MATERIALS

- A. Substrate Priming Materials shall be equal to HYDROCID PRIMER #75, a low VOC waterborne acrylic primer.
- B. Crack Preparation Materials: Equal to MasterProtect FL746, FL747, FL748, and FL750 acrylic emulsion formulations for repairing non-moving cracks that have been chipped out or routed if larger than hairline. Knife grade, smooth and textured (#748 and #746 respectively) and brush grade, smooth and textured (#750 and #747 respectively) are used to match existing substrate textures.
- C. Elastomeric Coating: High performance finish coating shall be equal to HYDROCID COLORFLEX.
 - 1. Contain by volume a minimum of 53 percent nonvolatile solids, exhibit an elongation factor of 400 percent minimum, be 100 percent acrylic, be internally plasticized resulting in elasticity derived from a combination of special compositions, molecular weight and cross-linking, all to produce a weatherproof coating capable of being applied at 10 to 13 mils, dry film thickness, by spray, roller, or brush.
 - 2. Possess crack-bridging capabilities because of polymer's low glass transition temperatures and maintain elastomeric
 - 3. Be available in tint bases according to color requirements of Architect or Owner.
- D. Repair Mortar shall be equal to SONOCRETE GEL PATCH, a one component, polymer-modified Portland cement repair mortar.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Inspect all areas involved in work to establish extent of work, access and need for protection of surrounding construction, windows and shrubbery.
- B. Protect all surroundings from HYDROCID Primer, Patching Repair Compounds and Finish products and to include, but not be limited to, windows, roofs, walkways, drives, and landscaping.
- C. Conduct all pre-application inspections of site verification with an authorized Manufacturer's Representative.
- D. Inspect all mortar joints to ensure there are no gaps, cracks or voids greater than 0.002 inches (2 mils). Repair all gaps, cracks or voids greater than 0.002 inches (2 mils).

3.02 PATCHING APPLICATION

- A. Mixing Procedure
 - 1. Mix SONOCRETE GEL PATCH with 3-1/4 quarts clean water per 50 pound bag in a clean container. Sift powder into container in thirds. Mix continuously at slow speed to avoid air entrapment. Mix for a minimum of three minutes. Mix will appear dry until full mix time is accomplished.
 - 2. Mix no more material than can be placed in 20 to 30 minutes at 70 degrees F and 50 percent relative humidity.
- B. Placement
 - 1. Remove standing water from pre-dampening.
 - 2. Chip or grind out cracks larger than 1/16 inch and fill with polymer modified mortar.
 - 3. Place repair mortar onto wet scrub coat of SONOCRETE GEL PATCH. Apply scrub coat with a stiff bristle brush.
 - 4. Score successive lifts and allow each to set before applying next layer.
 - 5. Trowel to rough finish after initial set.
- C. Curing:
 - 1. Wet cure patch when temperatures are above 85 degrees F or relative humidity is below 30 percent or wind speed exceeds 15 mph or patches exposed to direct sunlight for 72 hours after placement.
 - 2. Cure patches with SONNEBORN KURE-N-SEAL W, if temperatures are above 85 degrees F or relative humidity is below 30 percent or wind speeds exceed 15 mph or patches exposed to direct sunlight for 72 hours after placement, only if wet curing cannot be accomplished or as directed by Engineer. Do not use solvent containing curing compounds.

3.03 COATING APPLICATION - PAINTED SURFACES

- A. Pressure wash all surfaces to be coated at a minimum 2100 psi to remove dirt, excess chalk, loose paint, salt, and other contaminants.
- B. Remove mildew and fungus to deter subsequent growth by washing surfaces vigorously with a solution of 1 tablespoon of detergent and 1 to 2 pints liquid bleach in a gallon of water. Rinse thoroughly with clear water. Treat severely infested substrates a second time after an interval of 1 to 2 weeks to further promote elimination of growth. Allow walls to dry a minimum of 24 hours before application of primer.
- C. Prime cleaned surfaces with 1 coat of Hydrocide Primer #751 so that no glaze (sheen) results. Coverage rate will vary with density, porosity, and finish of stucco (175 to 350 square feet per gallon). Apply in accordance with manufacturer's written instructions.

- D. Treat cracks 1/16 inch or less by applying a liberal amount of Patching Compound, (selected to most closely match substrate), directly over crack and extending it beyond crack no less than 4 inches. Leave approximately 1/4 inch thickness of material directly over crack. Allow Patching Compound to achieve a thick skin before application of coating. Temperature and relative humidity will directly affect dry time.
- E. Juncture Details: Apply and tool a liberal amount of Patching Compound or a cant bead of Sonolastic NP 1 wherever there is a change in direction where two walls abut and at column and wall intersections.
- F. All preparatory work shall be acceptable to manufacturer's representative before proceeding to application of elastomeric finish coat.
- G. Finish Coats: Apply 2 pinhole-free finish coats of Hydrocide Colorflex at rate of 60 to 90 square feet per gallon to Concrete Masonry to achieve a minimum 10 to 13 dry mils, 60 to 80 square feet per gallon to achieve a minimum 10 to 13 dry mils to block.

3.04 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service. Final inspection: Warranty request. Manufacturer's representative will inspect finished surface preparation, application, and finished coating and may require further preparation or application to achieve appropriate result. In no case will manufacturer's representative approve surface or finish if following conditions are found: pinholes, insufficient coating thickness, loose paint, paint with curled edges, cracks with loose edges, loose stucco (to be determined by sounding method), or any other conditions, which, in manufacturer's representative's opinion, may cause failure of installation.

3.05 CLEANING

- A. Remove wet HYDROCID E Primers, Patching Repair Compounds and Finish products from tools and equipment with water. Remove dried materials mechanically.
- B. Clean wet SONOCRETE GEL PATCH, tools, and equipment with water.
- C. Clean up and properly dispose of all debris remaining on job site related to application.

END OF SECTION 09 96 53

SECTION 10 14 00 - SIGNAGE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. General Coordination Procedures, (Reference Specification Section 01 31 00) General Contractor shall coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work that depend on each other for proper installation, connection, and operation.

1.02 SUMMARY

- A. Section Includes:
 - 1. Work includes all labor, materials, equipment and services necessary to furnish and install all signage as shown on the Drawings and as herein specified.
- B. Related Sections include the following:
 - 1. Division 01 - for Project Identification signage.
 - 2. Division 05 - Section "Metal Fabrications", for vehicular sign posts.
 - 3. Division 06 - Section "Rough Carpentry", for blocking in walls.
 - 4. Division 09 - Section "Gypsum Board Assemblies".
 - 5. Division 10 - Section "Fire Protection Specialties", for fire extinguisher / cabinets
 - 6. Division 14, for elevator signage and sign fixtures.
 - 7. Division 26 - For lighting and electrical requirements for lit signage.
 - 8. Division 32 - Section "Pavement Specialties", for fire lane, directional, and other pavement markings.
 - 9. Division 32 - Section "Decorative Metal Fencing and Gates", for safety signage for motorized gates.

1.03 SUBMITTALS

- A. Submit shop drawings for all work for review prior to fabrication of materials. Shop drawings of individual letter signage shall indicate spacing. Shop drawings of all signage shall be drawn to scale, letter characters in type style specified and spacing shown exactly as sign is to be fabricated.
- B. Submit samples of all colors for selection by Architect and materials proposed for use prior to fabrication.
- C. Submit two product sample signs with pictogram, tactile characters, and Braille.
- D. Submit sign schedule location key plan for all signage.
- E. Sign schedule location key plan: Signage contractor shall submit a first draft sign schedule and location key plan for all signage in editable electronic format (excel preferred). Preliminary submittal shall indicate all proposed sign locations, types, and message copy. Architect will mark up the draft schedule and location plan. Make corrections and resubmit sign schedule and location plan until approved by Architect.
 - 1. Signage contractor shall spell check all signage copy and inform Architect in the final sign schedule submittal to confirm suspected misspellings.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Materials properly protected and packaged so that no damage occurs during transit. Materials when delivered, protected by the Contractor against damage or theft.

1.05 QUALITY ASSURANCE

- A. Signage shall meet government regulation for raised image signage and criteria of the Americans with Disabilities Act, and Texas Accessibility Standards (TAS).
 - 1. Contractor shall be responsible for all TAS and local accessibility code signage requirements, regardless of whether they are specifically shown on the drawings or specified herein. Notify Architect of any conflicts or deficiencies. Any signage deficiencies noted by Authorities having Jurisdiction at the conclusion of the project shall be remedied by Contractor at no additional cost to the Owner.

1.06 WARRANTY

- A. Fabricator's Special Warranty: Manufacturer / Fabricator agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, the following:
 - 1. Deterioration of finishes beyond normal weathering.
 - 2. Deterioration of printed images.
 - 3. Separation or delamination of sheet materials and components.
 - 4. Failure of mechanical fasteners or components.
 - 5. Separation of signs from substrates due to improper substrate preparation or due to inadequate strength or quantity of fasteners or adhesives.
 - a. If defect is exhibited in a significant number of locations to indicate a systemic issue, corrections to attachments shall be made holistically to the type(s) of signs exhibiting the defect.
 - 6. Warranty excludes damage due to vandalism or abuse.
 - 7. Warranty Period: One years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Signage Design, General: Information on Drawings and as specified herein establish the design intent only, showing requirements for respective aesthetic effects and performance characteristics of signage but not necessarily all fabrication details required for complete sign installations.
 - 1. Architect will provide a preliminary signage schedule, with all preliminary proposed copy. Signage contractor is responsible to translate into complete signage submittal package for Architect's review and comment, and Owner approval.
 - 2. Architect or Owner will provide electronic graphic files in vector format acceptable to signage fabricator for use in preparing all printed graphic images.
- B. Font for Copy: As noted in Drawings or otherwise approved by Architect
 - 1. Where or if individual characters conflict with handicap accessible code requirements, replace individual characters with similar appearance characters compliant with code requirements, or replace with similar appearance compliant font, as approved by Architect.
- C. Accessibility Standards: Comply with accessibility standards indicated in References article. In the event of apparent conflict between Requirements and signage design indicated, notify Architect via submittal process and suggest corrections to design to maintain design intent and resolve the conflict. Coordinate with Architect to resolve conflicts in satisfactory manner.

1. Architect's review and approval of submittals is for general conformance with design intent and does not constitute review or approval of handicap accessible features.
2. Signage fabricator is solely responsible to fabricate signs requiring accessible features in compliance with the provisions of applicable handicap accessibility codes. In event that non-compliant signage is installed and verified by authorities having jurisdiction as non-compliant, fabricator shall replace identified non-compliant signage with compliant signage of similar design, without additional cost to Owner.

2.02 MATERIALS

- A. Materials, General: Materials and equipment as well as workmanship shall conform to the highest commercial standards available. Parts not identified specifically on Drawings shall be materials appropriate to job site conditions. All color changes made with sharp, clean even edges providing clear separation of sign copy.
- B. Aluminum Castings: ASTM B 26/B 26M, of alloy and temper recommended by sign manufacturer for casting process used and for use and finish indicated.
- C. Aluminum Sheet and Plate: ASTM B 209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- D. Acrylic Sheet: ASTM D 4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).
- E. Vinyl Film: UV-resistant vinyl film of nominal thickness indicated, with pressure-sensitive, permanent adhesive on back; die cut to form characters or images as indicated and suitable for exterior applications.
- F. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure indicated.
- G. Bronze Castings: ASTM B 584, Alloy UNS No. C86500 (No. 1 manganese bronze).

2.03 FABRICATED ALUMINUM

- A. Manufacturers: Subject to compliance with requirements, provide products by:
 1. Gemini Incorporated.
- B. Aluminum Fabricated Numeral signage: Produce numeral with smooth flat faces, sharp corners and precisely formed lines and profiles.
 1. Material: Aluminum
 2. Depth: 2" minimum
 3. Mounting: Concealed studs, non-corroding for substrates encountered, and projected 1" from wall.
 4. Character Font: Twentieth Century Modern
 5. Exterior Color: Painted color to be selected by Architect from manufacturer's full range (including metallic colors).
- C. Aluminum Fabricated Logo signage: Laser cut signage
 1. Material: Aluminum
 2. Mounting: Aluminum Standoffs
 3. Color: Power coated RAL 3002
 4. Size: Refer to drawings

2.04 PANEL SIGNS

- A. Manufacturers: Subject to compliance with requirements, provide products by:
 - 1. Best Sign Systems Inc.
 - 2. Gemini Incorporated.
 - 3. InPro Corporation
- B. Exterior Handicap Parking Signage:
 - 1. Sign Type: 16" Gauge galvanized steel with 1" radius corners, shop painted and screw attached to 2" galvanized pipe post set in concrete footing. Allow for 1 sign including van accessible.
 - 2. Refer to site plan and handicap signage detail on drawings.

2.05 ACCESSORIES

- A. Anchors and Inserts: Provide nonferrous-metal anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel or lead expansion-bolt devices for drilled-in-place anchors. Furnish inserts, as required, to be set into concrete or masonry work.

2.06 FABRICATION

- A. General: Provide manufacturer's standard signs of configurations indicated.
 - 1. Welded Connections: Comply with AWS standards for recommended practices in shop welding. Provide welds behind finished surfaces without distortion or discoloration of exposed side. Clean exposed welded surfaces of welding flux and dress exposed and contact surfaces.
 - 2. Mill joints to tight, hairline fit. Form joints exposed to weather to exclude water penetration.
 - 3. Preassemble signs in the shop to greatest extent possible. Disassemble signs only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation, in location not exposed to view after final assembly.
 - 4. Conceal fasteners.

2.07 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.08 ALUMINUM FINISHES

- A. Baked-Enamel Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Apply baked enamel complying with paint manufacturer's written instructions for cleaning, conversion coating, and painting.
 - 1. Organic Coating: Thermosetting, modified-acrylic enamel primer/topcoat system complying with AAMA 2603 except with a minimum dry film thickness of 1.5 mils, medium gloss.

PART 3 - EXECUTION

3.01 EXAMINATION AND COORDINATION

- A. Coordinate mounting requirements for exterior substrates with other trades as required, including adequate strength and structural reinforcements where necessary.
- B. Coordinate with other trades as required for blocking in walls, electrical requirements, requirements for substrate preparation, and other requirements for signage installation as applicable.
- C. Examine installation areas to ensure that conditions are suitable for installation.
- D. Examine existing conditions for construction or obstructions that prohibit signage to be installed in typical locations per TAS standards. Where location for TAS compliant mounting location is unclear, request clarification from Architect.
- E. Examine signage for defects prior to installation. Do not install damaged signage.
- F. Prepare shop drawings and schedule production of dedication plaque with adequate time for review, approval and fabrication to ensure the plaque will be installed at substantial completion, or other date as may be required for dedication ceremony.
 - 1. Submit initial shop drawings no later than 2 months plus fabrication time, prior to scheduled substantial completion date, to ensure adequate time for Owner review and approval of dedication plaque.

3.02 PREPARATION

- A. Verify mounting locations and types prior to fabrication. Coordinate exact locations with Architect where signs cannot be installed in typical location per Texas Accessibility Standards. Confirm where backplates etc. are needed for application to glass or similar substrates.
- B. Fabricate signs according to approved shop drawings and sign schedule.
- C. Clean mounting locations of dirt, dust, grease or similar conditions that would prevent proper installation. This signage contractor responsible to properly clean substrates so that signage may be properly applied.

3.03 INSTALLATION

- A. Locate signs and accessories where indicated, using mounting methods of types described and complying with manufacturer's written instructions.
 - 1. Install signs level, plumb, and at heights indicated, with sign surfaces free of distortion and other defects in appearance.
 - 2. Interior Wall Signs: Install signs on walls adjacent to latch side of door where applicable. Where not indicated or possible, such as double doors, install signs on nearest adjacent walls. Locate to allow approach within 3 inches of sign without encountering protruding objects or standing within swing of door. Coordinate exact location with Architect.

- B. Wall-Mounted Signs: Comply with sign manufacturer's written instructions except where more stringent requirements apply.
 - 1. Two-Face Tape: Mount signs to smooth, nonporous surfaces. Do not use this method for vinyl-covered or rough surfaces.
 - 2. Silicone-Adhesive Mounting: Attach signs to irregular, porous, or vinyl-covered surfaces.
 - 3. Shim Plate Mounting: Provide 1/8-inch thick, concealed aluminum shim plates with predrilled and countersunk holes, at locations indicated, and where other mounting methods are not practicable. Attach plate with fasteners and anchors suitable for secure attachment to substrate. Attach panel signs to plate using method specified above.
- C. Dimensional Characters: Mount characters using standard fastening methods to comply with manufacturer's written instructions for character form, type of mounting, wall construction, and condition of exposure indicated. Provide heavy paper template to establish character spacing and to locate holes for fasteners.
 - 1. Projected Mounting: Mount characters at projection distance 1-inch from wall surface indicated.
- D. Exterior aluminum letters applied to clean, sound substrate. Letters installed securely, level, plumb, and true in spacing.
- E. Interior signage applied to clean, sound substrate. This signage contractor responsible to properly clean substrates so that letters may be properly applied. Materials installed level, plumb, and true in spacing. Coordinate exact location with Architect.

3.04 CLEANING, PROTECTION, AND REPAIR

- A. Protect installed signage from damage and soiling due to construction operations.
 - 1. Install interior wall signage after substrates to receive painted finish have been painted, or if painting must be scheduled after initial sign installation mask off or remove and reinstall signs.
- B. Remove adhesive, paint, or other spills and smears from sign surfaces, prior to inspection for substantial completion. Clean signs according to manufacturer's or fabricator's instructions. Do not use cleaners or methods that can damage sign surface or finish.
- C. Remove any protective coatings at times as recommended by manufacturer or fabricator.
- D. Repair scratches and other damage that might have occurred during installation or due to construction operations to satisfaction of the Architect. Evidence of repair should not be visible when viewed with unaided eye at a distance of 5 feet. Remove and replace damaged materials that cannot be repaired to the satisfaction of the Architect.

END OF SECTION 10 14 00

SECTION 22 05 23 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Brass ball valves.
 - 2. Bronze ball valves.
- B. Related Sections:
 - 1. Section 22 05 53 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
 - 2. Section 22 11 16 "Domestic Water Piping" for valves applicable only to this piping.
 - 3. Section 22 13 19 "Sanitary Waste Piping Specialties" for valves applicable only to this piping.

1.03 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Nonrising stem.
- E. OS&Y: Outside screw and yoke.
- F. RS: Rising stem.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of valve indicated.

1.05 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
 - 1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - 2. ASME B31.1 for power piping valves.
 - 3. ASME B31.9 for building services piping valves.
- C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Set angle, gate, and globe valves closed to prevent rattling.
 - 4. Set ball and plug valves open to minimize exposure of functional surfaces.
 - 5. Set butterfly valves closed or slightly open.
 - 6. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to valve schedule articles for applications of valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.

2.02 BRASS BALL VALVES

A. Two-Piece, Full-Port, Brass Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Nibco
 - b. Milwaukee
 - c. Apollo
2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two piece.
 - e. Body Material: Forged brass.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Stainless steel.
 - i. Ball: Stainless steel, vented.
 - j. Port: Full.

B. Three-Piece, Full-Port, Brass Ball Valves with Brass Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Nibco
 - b. Milwaukee
 - c. Apollo
2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Three piece.
 - e. Body Material: Forged brass.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Brass.
 - i. Ball: Chrome-plated brass.
 - j. Port: Full.

2.03 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Nibco
 - b. Milwaukee
 - c. Apollo
2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Stainless steel.
 - i. Ball: Stainless steel, vented.
 - j. Port: Full.

B. Three-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Nibco
 - b. Milwaukee
 - c. Apollo
2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Three piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Stainless steel.
 - i. Ball: Stainless steel, vented.
 - j. Port: Full.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.02 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.

3.03 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.04 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- C. Select valves, except wafer types, with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
6. For Steel Piping, NPS 5 and Larger: Flanged ends.
7. For Grooved-End Copper Tubing and Steel Piping: Valve ends may be grooved.

3.05 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Ball Valves: Two piece, full port, brass or bronze with stainless-steel trim.
2. Bronze Swing Check Valves: Class 125, nonmetallic disc.

B. Pipe NPS 2-1/2 and Larger:

1. Iron Ball Valves: Class 150.
2. Iron, Grooved-End Butterfly Valves: 175 CWP.
3. Iron Swing Check Valves: Class 125, nonmetallic-to-metal seats.
4. Iron, Grooved-End Swing Check Valves: 300 CWP.

END OF SECTION 22 05 23

SECTION 22 11 16 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Under-building-slab and aboveground domestic water pipes, tubes, and fittings inside buildings.

1.03 ACTION SUBMITTALS

- A. Product Data: For transition fittings and dielectric fittings.

PART 2 - PRODUCTS

2.01 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.
- B. Potable-water piping and components shall comply with NSF 14 and NSF 61. Plastic piping components shall be marked with "NSF-pw."

2.02 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.
- B. Soft Copper Tube: ASTM B 88, Type K water tube, annealed temper.
- C. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
- D. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.

E. Copper Unions:

1. MSS SP-123.
2. Cast-copper-alloy, hexagonal-stock body.
3. Ball-and-socket, metal-to-metal seating surfaces.
4. Solder-joint or threaded ends.

F. Copper Pressure-Seal-Joint Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Viega
 - b. Nibco
2. Fittings for NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber, O-ring seal in each end.
3. Fittings for NPS 2-1/2 to NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber, O-ring seal in each end.

G. Appurtenances for Grooved-End Copper Tubing:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Victaulic
2. Bronze Fittings for Grooved-End, Copper Tubing: ASTM B 75 copper tube or ASTM B 584 bronze castings.
3. Mechanical Couplings for Grooved-End Copper Tubing:
 - a. Copper-tube dimensions and design similar to AWWA C606.
 - b. Ferrous housing sections.
 - c. EPDM-rubber gaskets suitable for hot and cold water.
 - d. Bolts and nuts.
 - e. Minimum Pressure Rating: 300 psig.

2.03 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials:

1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
2. Full-face or ring type unless otherwise indicated.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

- C. Solder Filler Metals: ASTM B 32, lead-free alloys.
- D. Flux: ASTM B 813, water flushable.

2.04 TRANSITION FITTINGS

- A. General Requirements:
 - 1. Same size as pipes to be joined.
 - 2. Pressure rating at least equal to pipes to be joined.
 - 3. End connections compatible with pipes to be joined.
- B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

2.05 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Unions:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 2. Standard: ASSE 1079.
 - 3. Pressure Rating: 125 psig minimum at 180 deg F.
 - 4. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 2. Standard: ASSE 1079.
 - 3. Factory-fabricated, bolted, companion-flange assembly.
 - 4. Pressure Rating: 125 psig minimum at 180 deg F.
 - 5. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- D. Dielectric Nipples:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 2. Standard: IAPMO PS 66.
 - 3. Electroplated steel nipple complying with ASTM F 1545.
 - 4. Pressure Rating and Temperature: 300 psig at 225 deg F.
 - 5. End Connections: Male threaded or grooved.

6. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.01 EARTHWORK

- A. Comply with requirements in Section 31 20 00 "Earth Moving" for excavating, trenching, and backfilling.

3.02 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
- C. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for pressure gages in Section 22 05 19 "Meters and Gages for Plumbing Piping" and with requirements for drain valves and strainers in Section 22 11 19 "Domestic Water Piping Specialties."
- D. Install shutoff valve immediately upstream of each dielectric fitting.
- E. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Section 22 11 19 "Domestic Water Piping Specialties."
- F. Install domestic water piping level without pitch and plumb.
- G. Rough-in domestic water piping for water-meter installation according to utility company's requirements.
- H. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- I. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

- J. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- K. Install piping to permit valve servicing.
- L. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.
- M. Install piping free of sags and bends.
- N. Install fittings for changes in direction and branch connections.
- O. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- P. Install pressure gages on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gages in Section 22 05 19 "Meters and Gages for Plumbing Piping."

3.03 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Braze Joints" chapter.
- E. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- F. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.
- G. Joint Construction for Grooved-End Copper Tubing: Make joints according to AWWA C606. Roll groove ends of tubes. Lubricate and install gasket over ends of

tubes or tube and fitting. Install coupling housing sections over gasket with keys seated in tubing grooves. Install and tighten housing bolts.

- H. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- I. Joint Construction for Solvent-Cemented Plastic Piping: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
- J. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.04 TRANSITION FITTING INSTALLATION

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
 - 1. Fittings for NPS 1-1/2 and Smaller: Fitting-type coupling.
 - 2. Fittings for NPS 2 and Larger: Sleeve-type coupling.
- C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition unions.

3.05 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric unions.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.

3.06 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
 2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
 3. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
 4. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.07 CLEANING

- A. Clean and disinfect potable domestic water piping as follows:
1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
 2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
 - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
 - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Repeat procedures if biological examination shows contamination.
 - e. Submit water samples in sterile bottles to authorities having jurisdiction.
- B. Clean non-potable domestic water piping as follows:
1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
 2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:

- a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- C. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.
- D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.08 PIPING SCHEDULE

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Under-building-slab, domestic water, building-service piping, NPS 3 and smaller, shall be the following:
 - 1. Soft copper tube, ASTM B 88, Type K; copper pressure-seal fittings; and pressure-sealed joints.
- D. Under-building-slab, domestic water piping, NPS 2 and smaller, shall be one of the following:
 - 1. Hard copper tube, ASTM B 88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.
- E. Aboveground domestic water piping, NPS 2 and smaller, shall be one of the following:
 - 1. Hard copper tube, ASTM B 88, Type L; wrought-copper, solder-joint fittings; and soldered joints.
 - 2. Hard copper tube, ASTM B 88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.
- F. Aboveground domestic water piping, NPS 2-1/2 to NPS 4, shall be one of the following:
 - 1. Hard copper tube, ASTM B 88, Type L; wrought-copper, solder-joint fittings; and soldered joints.
 - 2. Hard copper tube, ASTM B 88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.

3. Hard copper tube, ASTM B 88, Type L; grooved-joint, copper-tube appurtenances; and grooved joints.

END OF SECTION 22 11 16

SECTION 22 11 26 - FACILITY LIQUEFIED-PETROLEUM GAS PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Pipes, tubes, and fittings.
 - 2. Piping specialties.
 - 3. Piping and tubing joining materials.
 - 4. Valves.
 - 5. Pressure regulators.
 - 6. Service meters.
 - 7. Storage containers.
 - 8. Concrete bases.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. LPG: Liquefied-petroleum gas.

1.4 PERFORMANCE REQUIREMENTS

- A. Minimum Operating-Pressure Ratings:
 - 1. For Piping Containing Only Vapor:
 - a. Piping and Valves: 125 psig unless otherwise indicated.
 - 2. For Piping Containing Liquid:

- a. Piping between Shutoff Valves: 350 psig unless otherwise indicated.
 - b. Piping Other Than Above: 250 psig unless otherwise indicated.
 - c. Valves and Fittings: 250 psig unless otherwise indicated.
 3. Minimum Operating Pressure of Service Meter: 5 psig.
- B. LPG System Pressure within Buildings: One pressure range. 0.5 psig or less.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of the following:
1. Piping specialties.
 2. Corrugated stainless-steel tubing with associated components.
 3. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
 4. Pressure regulators. Indicate pressure ratings and capacities.
 5. Service meters. Indicate pressure ratings and capacities. Include supports.
 6. Dielectric fittings.
 7. Storage containers.
- B. Shop Drawings: For facility LPG piping layout. Include plans, piping layout and elevations, sections, and details for fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to building structure. Detail location of anchors, alignment guides, and expansion joints and loops.
1. Shop Drawing Scale: 1/4 inch per foot.
 2. Detail mounting, supports, and valve arrangements for service meter assembly and pressure regulator assembly.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified professional engineer.
- B. Welding certificates.

1.7 CLOSEOUT SUBMITTALS

1.8 QUALITY ASSURANCE

- A. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Handling Flammable Liquids: Remove and dispose of liquids from existing LPG piping according to requirements of authorities having jurisdiction.
- B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- C. Store pipes and tubes with protective PE coating to avoid damaging coating and protect from direct sunlight.
- D. Protect stored PE pipes and valves from direct sunlight.

1.10 PROJECT CONDITIONS

- A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.

1.11 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.
- B. Coordinate requirements for access panels and doors for valves installed concealed behind finished surfaces. Comply with requirements in Section 08 31 13 "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedules 40 and 80, Type E or S, Grade B.
 - 1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
 - 2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
 - 3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
 - 4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 - a. Material Group: 1.1.
 - b. End Connections: Threaded or butt welding to match pipe.

- c. Lapped Face: Not permitted underground.
 - d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
 - e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground, and stainless steel underground.
 - 5. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.
 - a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.
 - 6. Mechanical Couplings:
 - a. Stainless-steel Steel flanges and tube with epoxy finish.
 - b. Buna-nitrile seals.
 - c. Stainless-steel bolts, washers, and nuts.
 - d. Coupling shall be capable of joining PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.
 - e. Steel body couplings installed underground on plastic pipe shall be factory equipped with anode.
- B. Corrugated, Stainless-Steel Tubing: Comply with ANSI/IAS LC 1.
- 1. Tubing: ASTM A 240/A 240M, corrugated, Series 300 stainless steel.
 - 2. Coating: PE with flame retardant.
 - a. 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.
 - 3. Fittings: Copper-alloy mechanical fittings with ends made to fit and listed for use with corrugated stainless-steel tubing and capable of metal-to-metal seal without gaskets. Include brazing socket or threaded ends complying with ASME B1.20.1.
 - 4. Striker Plates: Steel, designed to protect tubing from penetrations.
 - 5. Manifolds: Malleable iron or steel with factory-applied protective coating. Threaded connections shall comply with ASME B1.20.1 for pipe inlet and corrugated tubing outlets.
 - 6. Operating-Pressure Rating: 5 psig.
- C. Aluminum Tubing: Comply with ASTM B 210 and ASTM B 241/B 241M.
- 1. Aluminum Alloy: Alloy 5456 is prohibited.
 - 2. Protective Coating: Factory-applied coating capable of resisting corrosion on tubing in contact with masonry, plaster, insulation, water, detergents, and sewerage.
 - 3. Flare Fittings: Comply with ASME B16.26 and SAE J513.
 - a. Copper-alloy fittings.
 - b. Metal-to-metal compression seal without gasket.

- c. Dryseal threads shall comply with ASME B1.20.3.
- D. Drawn-Temper Copper Tube: Comply with ASTM B 88, Type K ASTM B 837, Type G.
 - 1. Copper Fittings: ASME B16.22, wrought copper, and streamlined pattern.
 - 2. Bronze Flanges and Flanged Fittings: ASME B16.24, Class 150.
 - a. Gasket Material: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
 - b. Bolts and Nuts: ASME B18.2.1, carbon steel or stainless steel.
 - 3. Protective Coating for Underground Tubing: Factory-applied, extruded PE a minimum of 0.022 inch thick.
- E. Annealed-Temper Copper Tube: Comply with ASTM B 88, Type K ASTM B 837, Type G.
 - 1. Copper Fittings: ASME B16.22, wrought copper, and streamlined pattern.
 - 2. Flare Fittings: Comply with ASME B16.26 and SAE J513.
 - a. Copper fittings with long nuts.
 - b. Metal-to-metal compression seal without gasket.
 - c. Dryseal threads complying with ASME B1.20.3.
 - 3. Protective Coating for Underground Tubing: Factory-applied, extruded PE a minimum of 0.022 inch thick.
- F. Tin-Lined Copper Tube: ASTM B 280, seamless, annealed, with interior tin-plated lining.
 - 1. Flare Fittings: Comply with ASME B16.26 and SAE J513.
 - a. Copper fittings with long nuts.
 - b. Metal-to-metal compression seal without gasket.
 - c. Dryseal threads complying with ASME B1.20.3.
- G. PE Pipe: ASTM D 2513, SDR 11.
 - 1. PE Fittings: ASTM D 2683, socket-fusion type or ASTM D 3261, butt-fusion type with dimensions matching PE pipe.

2.2 PIPING SPECIALTIES

- A. Appliance Flexible Connectors:
 - 1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
 - 2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
 - 3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
 - 4. Corrugated stainless-steel tubing with polymer coating.
 - 5. Operating-Pressure Rating: 0.5 psig.

6. End Fittings: Zinc-coated steel.
7. Threaded Ends: Comply with ASME B1.20.1.
8. Maximum Length: 72 inches

2.3 JOINING MATERIALS

- A. Joint Compound and Tape: Suitable for LPG.
- B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- C. Brazing Filler Metals: Alloy with melting point greater than 1000 deg F complying with AWS A5.8/A5.8M.

2.4 MANUAL GAS SHUTOFF VALVES

- A. See "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles for where each valve type is applied in various services.
- B. Metallic Valves, NPS 2 and Smaller for Liquid Service: Comply with ASME B16.33 and UL 842.
 1. CWP Rating: 250 psig.
 2. Threaded Ends: Comply with ASME B1.20.1.
 3. Socket ends for brazed joints.
 4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 5. Listing by CSA or agency acceptable to authorities having jurisdiction for valves 1 inch and smaller.
 6. Valves 1-1/4 inch and larger shall be suitable for LPG service, with "WOG" indicated on valve body.
- C. General Requirements for Metallic Valves, NPS 2 and Smaller for Vapor Service: Comply with ASME B16.33.
 1. CWP Rating: 125 psig.
 2. Threaded Ends: Comply with ASME B1.20.1.
 3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
 4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
 6. Service Mark: Valves 1-1/4 inch to NPS 2 shall have initials "WOG" permanently marked on valve body.

- D. General Requirements for Metallic Valves, NPS 2-1/2 and Larger: Comply with ASME B16.38.
1. CWP Rating: 125 psig.
 2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
 3. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 4. Service Mark: Initials "WOG" shall be permanently marked on valve body.
- E. One-Piece, Bronze Ball Valve with Bronze Trim: MSS SP-110.
1. Body: Bronze, complying with ASTM B 584.
 2. Ball: Chrome-plated brass.
 3. Stem: Bronze; blowout proof.
 4. Seats: Reinforced TFE; blowout proof.
 5. Packing: Separate packnut with adjustable-stem packing threaded ends.
 6. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 7. CWP Rating: 600 psig.
 8. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
 9. Service: Suitable for LPG service with "WOG" indicated on valve body.
- F. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.
1. Body: Bronze, complying with ASTM B 584.
 2. Ball: Chrome-plated bronze.
 3. Stem: Bronze; blowout proof.
 4. Seats: Reinforced TFE; blowout proof.
 5. Packing: Threaded-body packnut design with adjustable-stem packing.
 6. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 7. CWP Rating: 600 psig.
 8. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
 9. Service: Suitable for LPG service with "WOG" indicated on valve body.
- G. Two-Piece, Regular-Port Bronze Ball Valves with Bronze Trim: MSS SP-110.
1. Body: Bronze, complying with ASTM B 584.
 2. Ball: Chrome-plated bronze
 3. Stem: Bronze; blowout proof.
 4. Seats: Reinforced TFE.

5. Packing: Threaded-body packnut design with adjustable-stem packing.
6. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
7. CWP Rating: 600 psig.
8. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
9. Service: Suitable for LPG service with "WOG" indicated on valve body.

H. Bronze Plug Valves: MSS SP-78.

1. Body: Bronze, complying with ASTM B 584.
2. Plug: Bronze.
3. Ends: Threaded, socket, or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
4. Operator: Square head or lug type with tamperproof feature where indicated.
5. Pressure Class: 125 psig.
6. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
7. Service: Suitable for LPG service with "WOG" indicated on valve body.

I. Cast-Iron, Nonlubricated Plug Valves: MSS SP-78.

1. Body: Cast iron, complying with ASTM A 126, Class B.
2. Plug: Bronze or nickel-plated cast iron.
3. Seat: Coated with thermoplastic.
4. Stem Seal: Compatible with LPG.
5. Ends: Threaded or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
6. Operator: Square head or lug type with tamperproof feature where indicated.
7. Pressure Class: 125 psig.
8. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
9. Service: Suitable for LPG service with "WOG" indicated on valve body.

J. Cast-Iron, Lubricated Plug Valves: MSS SP-78.

1. Body: Cast iron, complying with ASTM A 126 Class B.
2. Plug: Bronze or nickel-plated cast iron.
3. Seat: Coated with thermoplastic.
4. Stem Seal: Compatible with LPG.

5. Ends: Threaded or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
6. Operator: Square head or lug type with tamperproof feature where indicated.
7. Pressure Class: 125 psig.
8. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
9. Service: Suitable for LPG service with "WOG" indicated on valve body.

K. PE Ball Valves: Comply with ASME B16.40.

1. Body: PE.
2. Ball: PE.
3. Stem: Acetal.
4. Seats and Seals: Nitrile.
5. Ends: Plain or fusible to match piping.
6. CWP Rating: 80 psig.
7. Operating Temperature: Minus 20 to plus 140 deg F.
8. Operator: Nut or flat head for key operation.
9. Include plastic valve extension.
10. Include tamperproof locking feature for valves where indicated on Drawings.

L. Valve Boxes:

1. Cast-iron, two-section box.
2. Top section with cover with "GAS" lettering.
3. Bottom section with base to fit over valve and barrel a minimum of 5 inches in diameter.
4. Adjustable cast-iron extensions of length required for depth of bury.
5. Include tee-handle, steel operating wrench with socket end fitting valve nut or flat head and with stem of length required to operate valve.

2.5 PRESSURE REGULATORS

A. General Requirements:

1. Single stage and suitable for LPG.
2. Steel jacket and corrosion-resistant components.
3. Elevation compensator.
4. End Connections: Threaded for regulators NPS 2 and smaller; flanged for regulators NPS 2-1/2 and larger.

B. Line Pressure Regulators: Comply with ANSI Z21.80.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Fisher Control Valves & Instruments; a brand of Emerson Process Management.

- b. Invensys.
 - c. Maxitrol Company.
- 2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
- 3. Springs: Zinc-plated steel; interchangeable.
- 4. Diaphragm Plate: Zinc-plated steel.
- 5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
- 6. Orifice: Aluminum; interchangeable.
- 7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
- 8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet and no pressure sensing piping external to the regulator.
- 9. Pressure regulator shall maintain discharge pressure setting downstream and not exceed 150 percent of design discharge pressure at shutoff.
- 10. Overpressure Protection Device: Factory mounted on pressure regulator.
- 11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
- 12. Maximum Inlet Pressure: 2 psig.

2.6 SERVICE METERS

- A. Diaphragm-Type Service Meters: Comply with ANSI B109.1.

- 1. Case: Die-cast aluminum.
- 2. Connections: Steel threads.
- 3. Diaphragm: Synthetic fabric.
- 4. Diaphragm Support Bearings: Self-lubricating.
- 5. Compensation: Continuous temperature and pressure.
- 6. Meter Index: Cubic feet.
- 7. Meter Case and Index: Tamper resistant.
- 8. Remote meter reader compatible.
- 9. Maximum Inlet Pressure: 100 psig.
- 10. Pressure Loss: Maximum 0.5-inch wg.
- 11. Accuracy: Maximum plus or minus 1.0 percent.

2.7 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

2.8 STORAGE CONTAINERS

- A. Description: Factory fabricated, complying with requirements in NFPA 58 and ASME Boiler and Pressure Vessel Code and bearing the ASME label. Tanks shall be rated for 250-psig minimum working pressure.
1. Liquid outlet and vapor inlet and outlet connections shall have shutoff valves with excess-flow safety shutoff valves and bypass and back-pressure check valves with smaller than 0.039-inch drill-size hole to equalize pressure. Liquid-fill connection shall have backflow check valve.
 - a. Connections: Color-code and tag valves to indicate type.
 - 1) Liquid fill and outlet, red.
 - 2) Vapor inlet and outlet, yellow.
 2. Level gage shall indicate current level of liquid in the container. Gages shall also indicate storage container contents; e.g., "Butane," "50-50 LPG Mix," or "Propane."
 3. Pressure relief valves, type and number as required by NFPA 58, connected to vapor space and having discharge piping same size as relief-valve outlet and long enough to extend at least 84 inches directly overhead. Identify relief valves as follows:
 - a. Discharge pressure in psig.
 - b. Rate of discharge for standard air in cfm.
 - c. Manufacturer's name.
 - d. Catalog or model number.
 4. Container pressure gage.
 5. For outdoor installation, exposed metal surfaces mechanically cleaned, primed, and painted for resistance to corrosion.
 6. Ladders for access to valves more than 72 inches aboveground.
 7. Stainless-Steel Nameplate: Attach to aboveground storage container or to adjacent structure for underground storage container.
 - a. Name and address of supplier or trade name of container.
 - b. Water capacity in gallons and liters.
 - c. Design pressure in psig (kPa).
 - d. Statement, "This container shall not contain a product having a vapor pressure in excess of 100 PSIG.."
 - e. Outside surface area in sq. ft. (sq. m).
 - f. Year of manufacture.
 - g. Shell thickness in inches (mm).
 - h. Overall length in feet (m).
 - i. OD in feet (m).
 - j. Manufacturer's serial number.
 - k. ASME Code label.
 8. Felt support pads and two concrete or painted-steel saddles per storage container. Corrosion protection required at container-to-felt contact.

9. Straps and anchors for tie-down slab.
10. Asphalt-based coating for corrosion protection.
11. Container connections and valves protected in manway at top of storage container.
12. Manway equipped with ventilation louvers.

2.9 LABELING AND IDENTIFYING

- A. Detectable Warning Tape: Acid- and alkali-resistant PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored yellow.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for LPG piping system to verify actual locations of piping connections before equipment installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EARTHWORK

- A. Comply with requirements in Section 31 20 00 "Earth Moving" for excavating, trenching, and backfilling.

3.3 PREPARATION

- A. Close equipment shutoff valves before turning off LPG to premises or piping section.
- B. Inspect LPG piping according to NFPA 58 and NFPA 54 the International Fuel Gas Code to determine that LPG utilization devices are turned off in piping section affected.
- C. Comply with NFPA 58 and NFPA 54 the International Fuel Gas Code requirements for prevention of accidental ignition.

3.4 OUTDOOR PIPING INSTALLATION

- A. Comply with NFPA 58 and NFPA 54 the International Fuel Gas Code requirements for installation and purging of LPG piping.

- B. Install underground, LPG piping buried at least 36 inches below finished grade. Comply with requirements in Section 31 20 00 "Earth Moving" for excavating, trenching, and backfilling.
 - 1. If LPG piping is installed less than 36 inches below finished grade, install it in containment conduit.
- C. Install underground, PE, LPG piping according to ASTM D 2774.
- D. Steel Piping with Protective Coating:
 - 1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.
 - 2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
 - 3. Replace pipe having damaged PE coating with new pipe.
- E. Copper Tubing with Protective Coating:
 - 1. Apply joint cover kits over tubing to cover, seal, and protect joints.
 - 2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
- F. Install fittings for changes in direction and branch connections.
- G. Joints for connection to inlets and outlets on vaporizers, air mixers, regulators, and valves may be flanged or threaded to match the equipment.
- H. Install pressure gage downstream from each service regulator. Pressure gages are specified in Section 23 05 19 "Meters and Gages for HVAC Piping."

3.5 INDOOR PIPING INSTALLATION

- A. Comply with NFPA 54 the International Fuel Gas Code for installation and purging of LPG piping.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.
- D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- G. Locate valves for easy access.
- H. Install LPG piping at uniform grade of 2 percent down toward drip and sediment traps.
- I. Install piping free of sags and bends.
- J. Install fittings for changes in direction and branch connections.
- K. Verify final equipment locations for roughing-in.
- L. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.
- M. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where readily accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.
 - 1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.
- N. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.
- O. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.
- P. Concealed Location Installations: Except as specified below, install concealed LPG piping and piping installed under the building in containment conduit constructed of steel pipe with welded joints as described in Part 2. Install a vent pipe from containment conduit to outdoors and terminate with weatherproof vent cap.
 - 1. Above Accessible Ceilings: LPG piping, fittings, valves, and regulators may be installed in accessible spaces without containment conduit.
 - 2. In Floors: Install LPG piping with welded or brazed joints and protective coating in cast-in-place concrete floors. Cover piping to be cast in concrete slabs with minimum of 1-1/2 inches of concrete. Piping may not be in physical contact with other metallic structures such as reinforcing rods or electrically neutral conductors. Do not embed piping in concrete slabs containing quick-set additives or cinder aggregate.
 - 3. In Floor Channels: Install LPG piping in floor channels. Channels must have cover and be open to space above cover for ventilation.
 - 4. In Walls or Partitions: Protect tubing installed inside partitions or hollow walls from physical damage using steel striker barriers at rigid supports.

- a. Exception: Tubing passing through partitions or walls does not require striker barriers.
- 5. Prohibited Locations:
 - a. Do not install LPG piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
 - b. Do not install LPG piping in solid walls or partitions.
- Q. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- R. Connect branch piping from top or side of horizontal piping.
- S. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.
- T. Do not use LPG piping as grounding electrode.
- U. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.
- V. Install pressure gage downstream from each line regulator. Pressure gages are specified in Section 23 05 19 "Meters and Gages for HVAC Piping."
- W. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 23 05 17 "Sleeves and Sleeve Seals for HVAC Piping."
- X. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 23 05 17 "Sleeves and Sleeve Seals for HVAC Piping."
- Y. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 23 05 18 "Escutcheons for HVAC Piping."

3.6 SERVICE-METER ASSEMBLY INSTALLATION

- A. Install service-meter assemblies aboveground, on concrete bases.
- B. Install metal shutoff valves upstream from service regulators. Shutoff valves are not required at second regulators if two regulators are installed in series.
- C. Install strainer on inlet of service-pressure regulator and meter set.
- D. Install service regulators mounted outside with vent outlet horizontal or facing down. Install screen in vent outlet if not integral with service regulator.

- E. Install metal shutoff valves upstream from service meters. Install dielectric fittings downstream from service meters.
- F. Install service meters downstream from pressure regulators.
- G. Install metal bollards to protect meter assemblies. Comply with requirements in Section 05 50 00 "Metal Fabrications" for pipe bollards.

3.7 VALVE INSTALLATION

- A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, aluminum, or copper connector.
- B. Install underground valves with valve boxes.
- C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.
- D. Install earthquake valves aboveground outside buildings according to listing.
- E. Install anode for metallic valves in underground PE piping.

3.8 PIPING JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints:
 - 1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
 - 2. Cut threads full and clean using sharp dies.
 - 3. Ream threaded pipe ends to remove burrs and restore full ID of pipe.
 - 4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
 - 5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- D. Welded Joints:
 - 1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
 - 2. Bevel plain ends of steel pipe.
 - 3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Ch. 22, "Pipe and Tube."
- F. Flanged Joints: Install gasket material, size, type, and thickness appropriate for LPG service. Install gasket concentrically positioned.
- G. Flared Joints: Cut tubing with roll cutting tool. Flare tube end with tool to result in flare dimensions complying with SAE J513. Tighten finger tight, then use wrench. Do not overtighten.
- H. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
 - 1. Plain-End Pipe and Fittings: Use butt fusion.
 - 2. Plain-End Pipe and Socket Fittings: Use socket fusion.

3.9 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for pipe hangers and supports specified in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment."
- B. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
 - 1. NPS 1 and Smaller: Maximum span, 96 inches; minimum rod size, 3/8 inch.
 - 2. NPS 1-1/4: Maximum span, 108 inches; minimum rod size, 3/8 inch.
 - 3. NPS 1-1/2 and NPS 2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
 - 4. NPS 2-1/2 to NPS 3-1/2: Maximum span, 10 feet; minimum rod size, 1/2 inch.
 - 5. NPS 4 and Larger: Maximum span, 10 feet; minimum rod size, 5/8 inch.
- C. Install hangers for horizontal, drawn-temper copper tubing with the following maximum spacing and minimum rod sizes:
 - 1. NPS 3/8: Maximum span, 48 inches; minimum rod size, 3/8 inch.
 - 2. NPS 1/2 and NPS 5/8: Maximum span, 72 inches; minimum rod size, 3/8 inch.
 - 3. NPS 3/4 and NPS 7/8: Maximum span, 84 inches; minimum rod size, 3/8 inch.
 - 4. NPS 1: Maximum span, 96 inches; minimum rod size, 3/8 inch.
- D. Install hangers for horizontal, corrugated stainless-steel tubing with the following maximum spacing and minimum rod sizes:
 - 1. NPS 3/8: Maximum span, 48 inches; minimum rod size, 3/8 inch.
 - 2. NPS 1/2: Maximum span, 72 inches; minimum rod size, 3/8 inch.
 - 3. NPS 3/4 and Larger: Maximum span, 96 inches; minimum rod, 3/8 inch.

3.10 CONNECTIONS

- A. Connect to utility's gas main according to utility's procedures and requirements.
- B. Install LPG piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.
- C. Install piping adjacent to appliances to allow service and maintenance of appliances.
- D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliances and equipment. Install union between valve and appliances or equipment.
- E. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.11 STORAGE CONTAINER INSTALLATION

- A. Fill storage container to at least 80 percent capacity with propane.
- B. Install piping connections with swing joints or flexible connectors to allow for storage container settlement and for thermal expansion and contraction.
- C. Ground containers according to NFPA 780. Grounding is specified in Section 26 41 13 "Lightning Protection for Structures."
- D. Set storage containers in felt pads on concrete or steel saddles. Install corrosion protection at container-to-felt contact.
- E. Set storage container on concrete ballast base large enough to offset buoyancy of empty storage container immersed in water.
- F. Install tie-down straps over container anchored in ballast base and repair damaged coating.
- G. Backfill with a minimum coverage for underground or mounded storage containers according to NFPA 58.
- H. Backfill with pea gravel as required in Section 31 20 00 "Earth Moving."
- I. Install cathodic protection for storage container. Cathodic protection is specified in Section 13 47 00 "Cathodic Protection."

3.12 LABELING AND IDENTIFYING

- A. Install detectable warning tape directly above gas piping, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.13 PAINTING

- A. Paint exposed, exterior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components with factory-applied paint or protective coating.
 - 1. Alkyd System: MPI EXT 5.1D.
 - a. Prime Coat: Alkyd anticorrosive metal primer.
 - b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
 - c. Topcoat: Exterior alkyd enamel (semigloss).
 - d. Color: Gray.
- B. Paint exposed, interior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components with factory-applied paint or protective coating.
 - 1. Latex Over Alkyd Primer System: MPI INT 5.1Q.
 - a. Prime Coat: Alkyd anticorrosive metal primer.
 - b. Intermediate Coat: Interior latex matching topcoat.
 - c. Topcoat: Interior latex (eggshell).
 - d. Color: Gray.
 - 2. Alkyd System: MPI INT 5.1E.
 - a. Prime Coat: Alkyd anticorrosive metal primer.
 - b. Intermediate Coat: Interior alkyd matching topcoat.
 - c. Topcoat: Interior alkyd (eggshell).
 - d. Color: Gray.
- C. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

3.14 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base.
 - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
 - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.

6. Use 3000-psig, 28-day, compressive-strength concrete and reinforcement as specified in Section 03 30 00 "Cast-in-Place Concrete." Section 03 30 53 "Miscellaneous Cast-in-Place Concrete."

3.15 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 1. Test, inspect, and purge LPG according to NFPA 58 and NFPA 54 the International Fuel Gas Code and requirements of authorities having jurisdiction.
- C. LPG piping will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.16 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain LPG equipment.

3.17 OUTDOOR PIPING SCHEDULE

- A. Underground LPG liquid piping shall be one of the following:
 1. Schedule 40 steel pipe with wrought-steel fittings and welded joints, or mechanical couplings. Coat pipe and fittings with protective coating for steel piping.
 2. -temper copper tube, Type K with wrought-copper fittings and brazed joints. Coat pipe and fittings with protective coating for copper tubing.
- B. Aboveground LPG liquid piping shall be one of the following:
 1. NPS 2 and Smaller: Schedule 40 steel pipe, malleable-iron threaded fittings and threaded and seal welded joints. Coat pipe and fittings with protective coating for steel piping.
 2. NPS 2-1/2 and Larger: Schedule 40, steel pipe with wrought-steel fittings and welded joints, or mechanical couplings. Coat pipe and fittings with protective coating for steel piping.
 3. -temper copper tube, Type L with wrought-copper fittings and brazed joints. Coat pipe and fittings with protective coating for copper tubing.
- C. Containment Conduit: Schedule 40, steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

3.18 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 0.5 PSIG

- A. Aboveground, branch piping NPS 1 and smaller shall be one of the following:
 - 1. Annealed-temper copper tube with wrought-copper fittings and joints.
 - 2. Schedule 40, steel pipe with malleable-iron fittings and threaded joints.
- B. Aboveground, distribution piping shall be one of the following:
 - 1. Schedule 40, steel pipe with malleable-iron fittings and threaded joints.

3.19 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES MORE THAN 0.5 PSIG3.45 kPa AND LESS THAN5 PSIG

- A. Aboveground, branch piping NPS 1 and smaller shall be one of the following:
 - 1. Annealed-temper copper tube, Type L with wrought-copper fittings and joints.
 - 2. Schedule 40, steel pipe with malleable-iron fittings and threaded joints.
- B. Aboveground, distribution piping shall be one of the following:
 - 1. Schedule 40, steel pipe with malleable-iron fittings and threaded joints.

3.20 UNDERGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

- A. Connections to Existing Gas Piping: Use valve and fitting assemblies made for tapping utility's gas mains and listed by an NRTL.
- B. Underground Vapor Piping:
 - 1. NPS 2 and Smaller: Bronze, lubricated plug valves.
 - 2. NPS 2-1/2 and Larger: Cast-iron, plug valves.

3.21 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

- A. Aboveground Liquid Piping:
 - 1. Two-piece, full-port, bronze ball valves with bronze trim.
- B. Valves for pipe NPS 2 and smaller at service meter shall be one of the following:
 - 1. Two-piece, -port, bronze ball valves with bronze trim.
 - 2. Bronze plug valve.
- C. Distribution piping valves for pipe NPS 2 and smaller shall be one of the following:
 - 1. Two-piece, full-port, bronze ball valves with bronze trim.

END OF SECTION 22 11 26

SECTION 22 13 16 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Pipe, tube, and fittings.

1.03 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
 - 1. Soil, Waste, and Vent Piping: 10-foot head of water.

1.04 ACTION SUBMITTALS

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

1.05 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF/ANSI 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.

PART 2 - PRODUCTS

2.01 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.02 PVC PIPE AND FITTINGS

- A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
- B. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- C. Adhesive Primer: ASTM F 656.
- D. Solvent Cement: ASTM D 2564.

PART 3 - EXECUTION

3.01 EARTH MOVING

- A. Comply with requirements for excavating, trenching, and backfilling specified in Section 31 20 00 "Earth Moving."

3.02 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install piping to permit valve servicing.
- C. Install piping at indicated slopes.
- D. Install piping free of sags and bends.
- E. Install fittings for changes in direction and branch connections.
- F. Install piping to allow application of insulation.

- G. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- H. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- I. Install soil and waste drainage and vent piping at the following minimum slopes unless otherwise indicated:
 - 1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
 - 2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
 - 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- J. Install aboveground PVC piping according to ASTM D 2665.
- K. Install underground PVC piping according to ASTM D 2321.
- L. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.03 JOINT CONSTRUCTION

- A. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

3.04 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.

- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

3.05 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - 2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping except outside leaders on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
 - 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
 - 5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 - 6. Prepare reports for tests and required corrective action.

3.06 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground, soil and waste piping NPS 4 and smaller shall be the following:
 - 1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
- C. Aboveground, vent piping NPS 4 and smaller shall be the following:
 - 1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
- D. Underground, soil, waste, and vent piping NPS 4 and smaller shall be the following:
 - 1. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
- E. Underground, soil and waste piping NPS 5 and larger shall be the following:
 - 1. Solid-wall PVC pipe; PVC socket fittings; and solvent-cemented joints.

END OF SECTION 22 13 16

SECTION 22 13 19 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Cleanouts.

1.03 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. FRP: Fiberglass-reinforced plastic.
- C. HDPE: High-density polyethylene plastic.
- D. PE: Polyethylene plastic.
- E. PP: Polypropylene plastic.
- F. PVC: Polyvinyl chloride plastic.

1.04 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

1.05 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

- C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

1.06 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Section 03 30 00 "Cast-in-Place Concrete."
- B. Coordinate size and location of roof penetrations.

PART 2 - PRODUCTS

2.01 CLEANOUTS

- A. Exposed Metal Cleanouts Refer to Plumbing Fixture Schedule on drawings.:
 - 1. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
 - 2. Size: Same as connected drainage piping
 - 3. Closure: Stainless-steel plug with seal.
 - 4. Size: Same as connected stack vent or vent stack.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
 - 1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
 - 2. Locate at each change in direction of piping greater than 45 degrees.
 - 3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
 - 4. Locate at base of each vertical soil and waste stack.

3.02 CONNECTIONS

- A. Comply with requirements in Section 22 13 16 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.

3.03 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 22 13 19

SECTION 26 05 19 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Building wires and cables rated 600 V and less.
 - 2. Connectors, splices, and terminations rated 600 V and less.
- B. Related Requirements:
 - 1. Section 26 05 23 "Control-Voltage Electrical Power Cables" for control systems communications cables and Classes 1, 2 and 3 control cables.
 - 2. Section 27 15 00 "Communications Horizontal Cabling" for cabling used for voice and data circuits.

1.03 ACTION SUBMITTALS

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

1.04 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Field quality-control reports.

1.05 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
 - 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

PART 2 - PRODUCTS

2.01 CONDUCTORS AND CABLES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide Service Wire or comparable product by one of the following:
 - 1. Alpha Wire Company.
 - 2. Southwire Company.
 - 3. Thomas & Betts Corporation; A Member of the ABB Group.
- C. Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658.
- D. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for, Type THHN-2-THWN-2,.

2.02 CONNECTORS AND SPLICES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide Hubbel Power Systems or comparable product by one of the following:
- C. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.03 SYSTEM DESCRIPTION

- A. 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.
- B. Comply with NFPA 70.

PART 3 - EXECUTION

3.01 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger, except VFC cable, which shall be extra flexible stranded.

3.02 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type THHN-2-THWN-2, single conductors in raceway.
- B. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN-2-THWN-2, single conductors in raceway.
- C. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-2-THWN-2, single conductors in raceway.
- D. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-2-THWN-2, single conductors in raceway.
- E. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-2-THWN-2, single conductors in raceway.
- F. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

3.03 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- B. Complete raceway installation between conductor and cable termination points according to Section 26 05 33 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- C. 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.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- F. Support cables according to Section 26 05 29 "Hangers and Supports for Electrical Systems."
- G. Complete cable tray systems installation according to Section 26 05 36 "Cable Trays for Electrical Systems" prior to installing conductors and cables.

3.04 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches of slack.

3.05 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 26 05 53 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.06 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 26 05 44 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.07 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 07 84 13 "Penetration Firestopping."

3.08 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors and conductors feeding the following critical equipment and services for compliance with requirements.
 - 2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 3. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.
 - a. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of Substantial Completion.
 - b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - c. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
- C. Test and Inspection Reports: Prepare a written report to record the following:
 - 1. Procedures used.
 - 2. Results that comply with requirements.
 - 3. Results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- D. Cables will be considered defective if they do not pass tests and inspections.

END OF SECTION 26 05 19

SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section includes grounding and bonding systems and equipment.
- B. Section includes grounding and bonding systems and equipment, plus the following special applications:
 - 1. Foundation steel electrodes.

1.03 ACTION SUBMITTALS

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

1.04 INFORMATIONAL SUBMITTALS

- A. As-Built Data: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article, including the following:
 - 1. Ground rods.
 - 2. Grounding arrangements and connections for separately derived systems.
- B. Qualification Data: For testing agency and testing agency's field supervisor.
- C. Field quality-control reports.

1.05 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:

- a. Instructions for periodic testing and inspection of grounding features at grounding connections for separately derived systems based on NFPA 70B.
 - 1) Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
 - 2) Include recommended testing intervals.

1.06 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
 - 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide Thomas & Betts or comparable product by one of the following:
 - 1. Burndy; Part of Hubbell Electrical Systems.
 - 2. ERICO International Corporation.
 - 3. O-Z/Gedney; a brand of Emerson Industrial Automation.

2.02 SYSTEM DESCRIPTION

- A. 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.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

2.03 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

2.04 CONNECTORS

- A. Listed and labeled by an NRTL 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.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- D. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

2.05 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel, sectional type; 3/4 inch by 10 feet.

PART 3 - EXECUTION

3.01 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. 2/0 AWG minimum.

1. Bury at least 24 inches below grade.
- C. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
1. Install bus horizontally, on insulated spacers 2 inches minimum from wall, 6 inches above finished floor unless otherwise indicated.
 2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.
- D. Conductor Terminations and Connections:
1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
 3. Connections to Structural Steel: Welded connectors.

3.02 GROUNDING AT THE SERVICE

- A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.03 GROUNDING SEPARATELY DERIVED SYSTEMS

- A. Generator: Install grounding electrode(s) at the generator location. The electrode shall be connected to the equipment grounding conductor and to the frame of the generator.

3.04 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. 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.
- C. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

- D. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.
- E. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.
- F. Metallic Fences: Comply with requirements of IEEE C2.
 - 1. Grounding Conductor: Bare, tinned copper, not less than No. 8 AWG.
 - 2. Gates: Shall be bonded to the grounding conductor with a flexible bonding jumper.
 - 3. Barbed Wire: Strands shall be bonded to the grounding conductor.

3.05 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Bonding Common 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 same as system grounding electrode conductor, and install in conduit.
- C. Ground Rods: Drive rods until tops are 2 inches 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 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 Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.

2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
 3. Use exothermic-welded connectors for outdoor locations; 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; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by 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. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install tinned bonding jumper to bond across flexible duct connections to achieve continuity.
- G. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet apart.
- H. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; use a minimum of 20 feet of bare copper conductor not smaller than No. 4 AWG.
1. If concrete foundation is less than 20 feet long, coil excess conductor within base of foundation.
 2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.

3.06 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
 3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at individual ground rods. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance no fewer 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.
 4. 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.
- C. Grounding system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.
- E. Report measured ground resistances that exceed the following values:
1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
 2. Substations and Pad-Mounted Equipment: 5 ohms.
- F. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 26 05 26

SECTION 26 05 33 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Nonmetal conduits, tubing, and fittings.
3. Metal wireways and auxiliary gutters.
4. Surface raceways.
5. Boxes, enclosures, and cabinets.

- B. Related Requirements:

1. Section 26 05 43 "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.
2. Section 27 05 28 "Pathways for Communications Systems" for conduits, wireways, surface pathways, innerduct, boxes, faceplate adapters, enclosures, cabinets, and handholes serving communications systems.
3. Section 28 05 28 "Pathways for Electronic Safety and Security" for conduits, surface pathways, innerduct, boxes, and faceplate adapters serving electronic safety and security.

1.03 DEFINITIONS

- A. ARC: Aluminum rigid conduit.
- B. GRC: Galvanized rigid steel conduit.
- C. IMC: Intermediate metal conduit.

1.04 ACTION SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

PART 2 - PRODUCTS

2.01 METAL CONDUITS, TUBING, AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. AFC Cable Systems; a part of Atkore International.
 2. Allied Tube & Conduit; a part of Atkore International.
 3. O-Z/Gedney; a brand of Emerson Industrial Automation.
 4. Thomas & Betts Corporation; A Member of the ABB Group.
 5. Wheatland Tube Company.
- B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. GRC: Comply with ANSI C80.1 and UL 6.
- D. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
1. Comply with NEMA RN 1.
 2. Coating Thickness: 0.040 inch, minimum.
- E. EMT: Comply with ANSI C80.3 and UL 797.
- F. FMC: Comply with UL 1; zinc-coated steel or aluminum.
- G. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- H. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
 2. Fittings for EMT:
 - a. Material: Steel.
 - b. Type: Setscrew or compression.
 3. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
 4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.
- I. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for

use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.02 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. AFC Cable Systems; a part of Atkore International.
 - 2. Niedax Inc.
 - 3. RACO; Hubbell.
 - 4. Thomas & Betts Corporation; A Member of the ABB Group; ENT Flexible Raceway.
- B. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
- D. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

2.03 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 3R unless otherwise indicated, and sized according to NFPA 70.
 - 1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Fittings and Accessories: Include covers, 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. Wireway Covers: Flanged-and-gasketed type unless otherwise indicated.
- D. Finish: Manufacturer's standard enamel finish.

2.04 SURFACE RACEWAYS

- A. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.05 BOXES, ENCLOSURES, AND CABINETS

- A. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- B. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- C. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, aluminum, Type FD, with gasketed cover.
- D. Metal Floor Boxes:
 - 1. Material: Cast metal.
 - 2. Type: Fully adjustable.
 - 3. Shape: Rectangular.
 - 4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.
- F. Paddle Fan Outlet Boxes: Nonadjustable, designed for attachment of paddle fan weighing 70 lb.
 - 1. Listing and Labeling: Paddle fan outlet boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- H. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- I. Device Box Dimensions: 4 inches by 2-1/8 inches by 2-1/8 inches deep.
- J. Gangable boxes are prohibited.
- K. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 3R with continuous-hinge cover with flush latch unless otherwise indicated.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 - 2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- L. Cabinets:

1. NEMA 250, Type 3R galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.
6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART 3 - EXECUTION

3.01 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed Conduit: GRC.
2. Concealed Conduit, Aboveground: GRC.
3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Indoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT.
2. Exposed and Subject to Severe Physical Damage: GRC. Raceway locations include the following:
 - a. Loading dock.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 - c. Mechanical rooms.
3. Concealed in Ceilings and Interior Walls and Partitions: EMT.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
5. Damp or Wet Locations: GRC.
6. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 nonmetallic in institutional and commercial kitchens and damp or wet locations.

C. Minimum Raceway Size: 3/4-inch trade size.

- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
 - 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
 - 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
 - 3. EMT: Use setscrew or compression, steel fittings. Comply with NEMA FB 2.10.
 - 4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
- E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- F. Install surface raceways only where indicated on Drawings.
- G. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg. F.

3.02 INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. Complete raceway installation before starting conductor installation.
- D. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for hangers and supports.
- E. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- F. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- H. Support conduit within 12 inches of enclosures to which attached.
- I. Raceways Embedded in Slabs:

1. Run conduit larger than 1-inchtrade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-footintervals.
 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
 3. Arrange raceways to keep a minimum of 2 inches of concrete cover in all directions.
 4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
 5. Change from ENT to GRC or IMC before rising above floor.
- J. Stub-ups to Above Recessed Ceilings:
1. Use EMT, IMC, or RMC for raceways.
 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- K. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- L. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.
- M. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- N. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inchtrade size and insulated throat metal bushings on 1-1/2-inchtrade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- O. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- P. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- Q. Cut conduit perpendicular to the length. For conduits 2-inchtrade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- R. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lbtensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

S. Surface Raceways:

1. Install surface raceway with a minimum 2-inch radius control at bend points.
2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

T. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.

U. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service raceway enters a building or structure.
3. Where otherwise required by NFPA 70.

V. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

W. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg. F and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC [and EMT] conduit that is located where environmental temperature change may exceed 100 deg. F and that has straight-run length that exceeds 100 feet.
2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
 - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg. F temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg. F temperature change.
 - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg. F temperature change.
 - d. Attics: 135 deg. F temperature change.
3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg. F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least

- 0.000078 inch per foot of length of straight run per deg. F of temperature change for metal conduits.
4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
 5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- X. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for recessed and semi-recessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
1. Use LFMC in damp or wet locations subject to severe physical damage.
 2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
- Y. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
- Z. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
- AA. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- BB. Locate boxes so that cover or plate will not span different building finishes.
- CC. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- DD. Set metal floor boxes level and flush with finished floor surface.

3.03 INSTALLATION OF UNDERGROUND CONDUIT

- A. Direct-Buried Conduit:
1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 31 20 00 "Earth Moving" for pipe less than 6 inches in nominal diameter.
 2. Install backfill as specified in Section 31 20 00 "Earth Moving."
 3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process.

Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 31 20 00 "Earth Moving."

4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete for a minimum of 12 inches on each side of the coupling.
 - b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
6. Warning Planks: Bury warning planks approximately 12 inches above direct-buried conduits but a minimum of 6 inches below grade. Align planks along centerline of conduit.
7. Underground Warning Tape: Comply with requirements in Section 26 05 53 "Identification for Electrical Systems."

3.04 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 26 05 44 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.05 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 07 84 13 "Penetration Firestopping."

3.06 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 26 05 33

SECTION 26 05 44 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
 - 2. Sleeve-seal systems.
 - 3. Sleeve-seal fittings.
 - 4. Grout.
 - 5. Silicone sealants.
- B. Related Requirements:
 - 1. Section 07 84 13 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.03 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.01 SLEEVES

- A. Wall Sleeves:
 - 1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
 - 2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

- B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.
- C. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
- D. Sleeves for Rectangular Openings:
 - 1. Material: Galvanized sheet steel.
 - 2. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches and with no side larger than 16 inches, thickness shall be 0.052 inch.
 - b. For sleeve cross-section rectangle perimeter 50 inches or more and one or more sides larger than 16 inches, thickness shall be 0.138 inch.

2.02 SLEEVE-SEAL SYSTEMS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 2. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 3. Pressure Plates: Carbon steel.
 - 4. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.03 SLEEVE-SEAL FITTINGS

- A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

2.04 GROUT

- A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

2.05 SILICONE SEALANTS

- A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
 - 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
- B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.01 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Comply with NECA 1.
- B. Comply with NEMA VE 2 for cable tray and cable penetrations.
- C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
 - 1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
 - a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 07 92 00 "Joint Sealants."
 - b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
 - 2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed.
 4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
 5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches above finished floor level. Install sleeves during erection of floors.
- D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
 2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.
- E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

3.02 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.
- B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.03 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 26 05 44

SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:

1. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Underground-line warning tape.
5. Warning labels and signs.
6. Instruction signs.
7. Equipment identification labels.
8. Miscellaneous identification products.

1.03 ACTION SUBMITTALS

- A. Product Data: For each electrical identification product indicated.

1.04 QUALITY ASSURANCE

- A. Comply with ANSI A13.1 and IEEE C2.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.05 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.01 POWER RACEWAY IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.
- B. Colors for Raceways Carrying Circuits at 600 V or Less:
 - 1. Black letters on an orange field.
 - 2. Legend: Indicate voltage and system or service type.
- C. Self-Adhesive Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- D. Snap-Around, Color-Coding Bands for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

2.02 ARMORED AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
- B. Colors for Raceways Carrying Circuits at 600 V and Less:
 - 1. Black letters on an orange field.
 - 2. Legend: Indicate voltage and system or service type.

- C. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- D. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches wide; compounded for outdoor use.

2.03 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
- B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

2.04 CONDUCTOR IDENTIFICATION MATERIALS

- A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.05 UNDERGROUND-LINE WARNING TAPE

- A. Tape:
 - 1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
 - 2. Printing on tape shall be permanent and shall not be damaged by burial operations.
 - 3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.
- B. Color and Printing:
 - 1. Comply with ANSI Z535.1 through ANSI Z535.5.
 - 2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE,-.
 - 3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE,-.
- C. Tag: Type ID:
 - 1. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that

allows inspection of the continuity of the conductive core, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.

2. Overall Thickness: 5 mils.
3. Foil Core Thickness: 0.35 mil.
4. Weight: 28 lb/1000 sq. ft..
5. 3-Inch Tensile According to ASTM D 882: 70 lbf, and 4600 psi.

2.06 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.
- C. Warning label and sign shall include, but are not limited to, the following legends:
 1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
 2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

2.07 INSTRUCTION SIGNS

- A. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.

2.08 EQUIPMENT IDENTIFICATION LABELS

- A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

2.09 CABLE TIES

- A. Plenum-Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.
 1. Minimum Width: 3/16 inch.
 2. Tensile Strength at 73 deg F, According to ASTM D 638: 7000 psi.
 3. UL 94 Flame Rating: 94V-0.
 4. Temperature Range: Minus 50 to plus 284 deg F.

5. Color: Black.

2.10 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- F. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-footmaximum intervals in straight runs, and at 25-footmaximum intervals in congested areas.
- G. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:
 1. Outdoors: UV-stabilized nylon.
 2. In Spaces Handling Environmental Air: Plenum rated.
- H. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.
- I. Painted Identification: Comply with requirements in painting Sections for surface preparation and paint application.

3.02 IDENTIFICATION SCHEDULE

- A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A, and 120 V to ground: Identify with self-adhesive vinyl tape applied in bands. Install labels at 30-foot maximum intervals.
- B. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:
 - 1. Emergency Power.
 - 2. Power.
 - 3. UPS.
- C. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.
 - 1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder, and branch-circuit conductors.
 - a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
 - b. Colors for 203/110-V Circuits:
 - 1) Phase A: Black.
 - 2) Phase B: Red.
 - 3) Phase C: Blue.
 - c. Colors for 403/117-V Circuits:
 - 1) Phase A: Brown.
 - 2) Phase B: Orange.
 - 3) Phase C: Yellow.
 - d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- D. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.
- E. Conductors to Be Extended in the Future: Attach marker tape to conductors and list source.

- F. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
 2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.
- G. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
1. Limit use of underground-line warning tape to direct-buried cables.
 2. Install underground-line warning tape for both direct-buried cables and cables in raceway.
- H. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.
1. Comply with 29 CFR 1910.145.
 2. Identify system voltage with black letters on an orange background.
 3. Apply to exterior of door, cover, or other access.
 4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:
 - a. Power transfer switches.
 - b. Controls with external control power connections.
- I. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
- J. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch-high letters for emergency instructions at equipment used for power transfer.
- K. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
1. Labeling Instructions:
 - a. Indoor Equipment: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch-

high letters on 1-1/2-inch-high label; where two lines of text are required, use labels 2 inches high.

- b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
- c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
- d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

2. Equipment to Be Labeled:

- a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be engraved, laminated acrylic or melamine label.
- b. Enclosures and electrical cabinets.
- c. Enclosed switches.
- d. Enclosed circuit breakers.
- e. Enclosed controllers.
- f. Contactors.
- g. Remote-controlled switches, dimmer modules, and control devices.
- h. Receptacles, lighting switches and junction boxes (type written label with panel and circuit number)

END OF SECTION 26 05 53

SECTION 26 05 73 - OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes computer-based, fault-current and overcurrent protective device coordination studies. Protective devices shall be set based on results of the protective device coordination study.
 - 1. Coordination of series-rated devices is permitted where indicated on Drawings.

1.03 ACTION SUBMITTALS

- A. Product Data: For computer software program to be used for studies.
- B. Other Action Submittals: The following submittals shall be made after the approval process for system protective devices has been completed. Submittals shall be in digital form.
 - 1. Coordination-study input data, including completed computer program input data sheets.
 - 2. Study and Equipment Evaluation Reports.
 - 3. Coordination-Study Report.

1.04 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For coordination-study specialist.
- B. Product Certificates: For coordination-study and fault-current-study computer software programs, certifying compliance with IEEE 399.

1.05 QUALITY ASSURANCE

- A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are not acceptable.
- B. Coordination-Study Specialist Qualifications: An entity experienced in the application of computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
 - 1. Professional engineer, licensed in the state where Project is located, shall be responsible for the study. All elements of the study shall be performed under the direct supervision and control of engineer.
- C. Comply with IEEE 242 for short-circuit currents and coordination time intervals.
- D. Comply with IEEE 399 for general study procedures.

PART 2 - PRODUCTS

2.01 COMPUTER SOFTWARE DEVELOPERS

- A. Available Computer Software Developers: Subject to compliance with requirements, companies offering computer software programs that may be used in the Work include, but are not limited to, the following:

2.02 COMPUTER SOFTWARE PROGRAM REQUIREMENTS

- A. Comply with IEEE 399.
- B. Analytical features of fault-current-study computer software program shall include "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.
- C. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance. Devices to be coordinated are indicated on Drawings.
 - 1. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

3.02 POWER SYSTEM DATA

- A. Gather and tabulate the following input data to support coordination study:
 - 1. Product Data for overcurrent protective devices specified in other electrical Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
 - 2. Impedance of utility service entrance.
 - 3. Electrical Distribution System Diagram: In hard-copy and electronic-copy formats, showing the following:
 - a. Circuit-breaker and fuse-current ratings and types.
 - b. Relays and associated power and current transformer ratings and ratios.
 - c. Transformer kilovolt amperes, primary and secondary voltages, connection type, impedance, and X/R ratios.
 - d. Generator kilovolt amperes, size, voltage, and source impedance.
 - e. Cables: Indicate conduit material, sizes of conductors, conductor material, insulation, and length.
 - f. Busway ampacity and impedance.
 - g. Motor horsepower and code letter designation according to NEMA MG 1.
 - 4. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:
 - a. Special load considerations, including starting inrush currents and frequent starting and stopping.
 - b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
 - c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.

- d. Generator thermal-damage curve.
- e. Ratings, types, and settings of utility company's overcurrent protective devices.
- f. Special overcurrent protective device settings or types stipulated by utility company.
- g. Time-current-characteristic curves of devices indicated to be coordinated.
- h. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
- i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
- j. Panelboards, switchboards, motor-control center ampacity, and interrupting rating in amperes rms symmetrical.

3.03 FAULT-CURRENT STUDY

- A. Calculate the maximum available short-circuit current in amperes rms symmetrical at circuit-breaker positions of the electrical power distribution system. The calculation shall be for a current immediately after initiation and for a three-phase bolted short circuit at each of the following:
 - 1. Switchgear and switchboard bus.
 - 2. Medium-voltage controller.
 - 3. Motor-control center.
 - 4. Distribution panelboard.
 - 5. Branch circuit panelboard.
- B. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Include studies of system-switching configurations and alternate operations that could result in maximum fault conditions.
- C. Calculate momentary and interrupting duties on the basis of maximum available fault current.
- D. Calculations to verify interrupting ratings of overcurrent protective devices shall comply with IEEE 141 IEEE 241 and IEEE 242.
 - 1. Transformers:
 - a. ANSI C57.12.10.
 - b. ANSI C57.12.22.
 - c. ANSI C57.12.40.

- d. IEEE C57.12.00.
 - e. IEEE C57.96.
 - 2. Medium-Voltage Circuit Breakers: IEEE C37.010.
 - 3. Low-Voltage Circuit Breakers: IEEE 1015 and IEEE C37.20.1.
 - 4. Low-Voltage Fuses: IEEE C37.46.
- E. Study Report:
- 1. Show calculated X/R ratios and equipment interrupting rating (1/2-cycle) fault currents on electrical distribution system diagram.
 - 2. Show interrupting (5-cycle) and time-delayed currents (6 cycles and above) on medium-and high-voltage breakers as needed to set relays and assess the sensitivity of overcurrent relays.
- F. Equipment Evaluation Report:
- 1. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
 - 2. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.
 - 3. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

3.04 COORDINATION STUDY

- A. Perform coordination study using approved computer software program. Prepare a written report using results of fault-current study. Comply with IEEE 399.
- 1. Calculate the maximum and minimum 1/2-cycle short-circuit currents.
 - 2. Calculate the maximum and minimum interrupting duty (5 cycles to 2 seconds) short-circuit currents.
 - 3. Calculate the maximum and minimum ground-fault currents.
- B. Comply with IEEE 141 IEEE 241 IEEE 242 recommendations for fault currents and time intervals.
- C. Transformer Primary Overcurrent Protective Devices:
- 1. Device shall not operate in response to the following:
 - a. Inrush current when first energized.
 - b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.

- c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.
- 2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.
- D. Motors served by voltages more than 600 V shall be protected according to IEEE 620.
- E. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and conductor melting curves in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.
- F. Coordination-Study Report: Prepare a written report indicating the following results of coordination study:
 - 1. Tabular Format of Settings Selected for Overcurrent Protective Devices:
 - a. Device tag.
 - b. Relay-current transformer ratios; and tap, time-dial, and instantaneous-pickup values.
 - c. Circuit-breaker sensor rating; and long-time, short-time, and instantaneous settings.
 - d. Fuse-current rating and type.
 - e. Ground-fault relay-pickup and time-delay settings.
 - 2. Coordination Curves: Prepared to determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:
 - a. Device tag.
 - b. Voltage and current ratio for curves.
 - c. Three-phase and single-phase damage points for each transformer.
 - d. No damage, melting, and clearing curves for fuses.
 - e. Cable damage curves.
 - f. Transformer inrush points.
 - g. Maximum fault-current cutoff point.
- G. Completed data sheets for setting of overcurrent protective devices.

END OF SECTION 26 05 73

SECTION 26 05 73.19 - OVERCURRENT PROTECTIVE DEVICE ARC-FLASH STUDY

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section includes a computer-based, arc-flash study to determine the arc-flash hazard distance and the incident energy to which personnel could be exposed during work on or near electrical equipment.

1.03 DEFINITIONS

- A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.
- B. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.
- C. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.
- D. SCCR: Short-circuit current rating.
- E. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

1.04 ACTION SUBMITTALS

- A. Product Data: For computer software program to be used for studies.
- B. Other Action Submittals: Submit the following submittals after the approval of system protective devices submittals. Submittals shall be in digital form.
 - 1. Arc-flash study input data, including completed computer program input data sheets.

2. Arc-flash study report; signed, dated, and sealed by a qualified professional engineer.
 - a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.

1.05 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Arc-Flash Study Specialist.
- B. Product Certificates: For arc-flash hazard analysis software, certifying compliance with IEEE 1584 and NFPA 70E.

1.06 CLOSEOUT SUBMITTALS

- A. Maintenance procedures according to requirements in NFPA 70E shall be provided in the equipment manuals.
- B. Operation and Maintenance Procedures: In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," provide maintenance procedures for use by Owner's personnel that comply with requirements in NFPA 70E.

1.07 QUALITY ASSURANCE

- A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.
- B. Arc-Flash Study Software Developer Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
 1. The computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.
- C. Arc-Flash Study Specialist Qualifications: Professional engineer in charge of performing the study, analyzing the arc flash, and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

- D. Field Adjusting Agency Qualifications: An independent agency, with the experience and capability to adjust overcurrent devices and to conduct the testing indicated, that is a member company of the International Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.01 COMPUTER SOFTWARE DEVELOPERS

- A. Comply with IEEE 1584 and NFPA 70E.
- B. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

2.02 SHORT-CIRCUIT STUDY REPORT CONTENT

- A. Executive summary.
- B. Study descriptions, purpose, basis and scope.
- C. One-line diagram, showing the following:
 - 1. Protective device designations and ampere ratings.
 - 2. Cable size and lengths.
 - 3. Transformer kilovolt ampere (kVA) and voltage ratings.
 - 4. Motor and generator designations and kVA ratings.
 - 5. Switchgear, switchboard, motor-control center and panelboard designations.
- D. Study Input Data: As described in "Power System Data" Article.
- E. Short-Circuit Study Output:
 - 1. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
 - a. Voltage.
 - b. Calculated symmetrical fault-current magnitude and angle.
 - c. Fault-point X/R ratio.
 - d. No AC Decrement (NACD) ratio.
 - e. Equivalent impedance.
 - f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
- F. Incident Energy and Flash Protection Boundary Calculations:

1. Arcing fault magnitude.
 2. Protective device clearing time.
 3. Duration of arc.
 4. Arc-flash boundary.
 5. Working distance.
 6. Incident energy.
 7. Hazard risk category.
 8. Recommendations for arc-flash energy reduction.
- G. Fault study input data, case descriptions, and fault-current calculations including a definition of terms and guide for interpretation of the computer printout.

2.03 ARC-FLASH WARNING LABELS

- A. Comply with requirements in Section 26 05 53 "Identification for Electrical Systems." Produce a 3.5-by-5-inch thermal transfer label of high-adhesion polyester for each work location included in the analysis.
- B. The label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:
1. Location designation.
 2. Nominal voltage.
 3. Flash protection boundary.
 4. Hazard risk category.
 5. Incident energy.
 6. Working distance.
 7. Engineering report number, revision number, and issue date.
- C. Labels shall be machine printed, with no field-applied markings.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine Project overcurrent protective device submittals. Proceed with arc-flash study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to arc-flash study may not be used in study.

3.02 SHORT-CIRCUIT STUDY

- A. Perform study following the general study procedures contained in IEEE 399.

- B. Calculate short-circuit currents according to IEEE 551.
- C. Base study on the device characteristics supplied by device manufacturer.
- D. The extent of the electrical power system to be studied is indicated on Drawings.
- E. Begin analysis at the service, extending down to the system overcurrent protective devices as follows:
 - 1. To normal system low-voltage load buses where fault current is 10 kA or less.
 - 2. Exclude equipment rated 240-V ac or less when supplied by a single transformer rated less than 125 kVA.
- F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Include studies of system-switching configurations and alternate operations that could result in maximum fault conditions.
- G. The calculations shall include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and shall apply to low- and medium-voltage, three-phase ac systems.
- H. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault and single line-to-ground fault at each of the following:
 - 1. Electric utility's supply termination point.
 - 2. Switchgear.
 - 3. Unit substation primary and secondary terminals.
 - 4. Low-voltage switchgear.
 - 5. Motor-control centers.
 - 6. Standby generators and automatic transfer switches.
 - 7. Branch circuit panelboards.

3.03 ARC-FLASH HAZARD ANALYSIS

- A. Comply with NFPA 70E and its Annex D for hazard analysis study.
- B. Use the short-circuit study output and the field-verified settings of the overcurrent devices.
- C. Calculate maximum and minimum contributions of fault-current size.
 - 1. The minimum calculation shall assume that the utility contribution is at a minimum and shall assume no motor load.
 - 2. The maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.

- D. Calculate the arc-flash protection boundary and incident energy at locations in the electrical distribution system where personnel could perform work on energized parts.
- E. Include medium- and low-voltage equipment locations, except 240-V ac and 208-V ac systems fed from transformers less than 125 kVA.
- F. Safe working distances shall be specified for calculated fault locations based on the calculated arc-flash boundary, considering incident energy of 1.2 cal/sq.cm.
- G. Incident energy calculations shall consider the accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations shall take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators shall be decremented as follows:
 - 1. Fault contribution from induction motors should not be considered beyond three to five cycles.
 - 2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g., contributions from permanent magnet generators will typically decay from 10 per unit to three per unit after 10 cycles).
- H. Arc-flash computation shall include both line and load side of a circuit breaker as follows:
 - 1. When the circuit breaker is in a separate enclosure.
 - 2. When the line terminals of the circuit breaker are separate from the work location.
- I. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.

3.04 POWER SYSTEM DATA

- A. Obtain all data necessary for the conduct of the arc-flash hazard analysis.
 - 1. Verify completeness of data supplied on the one-line diagram on Drawings. Call discrepancies to the attention of Architect.
 - 2. For new equipment, use characteristics submitted under the provisions of action submittals and information submittals for this Project.
 - 3. For existing equipment, whether or not relocated, obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers.
- B. Gather and tabulate the following input data to support coordination study. Comply with recommendations in IEEE 1584 and NFPA 70E as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the direct

supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.

1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Obtain electrical power utility impedance at the service.
3. Power sources and ties.
4. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in per cent, and phase shift.
5. For reactors, provide manufacturer and model designation, voltage rating and impedance.
6. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
7. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
8. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
9. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
10. Motor horsepower and NEMA MG 1 code letter designation.
11. Low-voltage cable sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).
12. Medium-voltage cable sizes, lengths, conductor material, and cable construction and metallic shield performance parameters.

3.05 LABELING

- A. Apply one arc-flash label for 600-V ac, 480-V ac, and applicable 208-V ac panelboards and disconnects and for each of the following locations:
 1. Motor-control center.
 2. Low-voltage switchboard.
 3. Switchgear.
 4. Medium-voltage switch.
 5. Control panel.

3.06 APPLICATION OF WARNING LABELS

- A. Install the arc-fault warning labels under the direct supervision and control of the Arc-Flash Study Specialist.

3.07 DEMONSTRATION

- A. Engage the Arc-Flash Study Specialist to train Owner's maintenance personnel in the potential arc-flash hazards associated with working on energized equipment and the significance of the arc-flash warning labels.

END OF SECTION 26 05 73.19

SECTION 26 09 23 - LIGHTING CONTROL DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Outdoor motion sensors.
- B. Time switches.
- C. Outdoor photo controls.

1.02 RELATED REQUIREMENTS

- A. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- B. Section 26 0537 - Boxes.
- C. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- D. Section 26 0918 - Remote Control Switching Devices: Remotely controlled devices for lighting control, including networked lighting controls, programmable relay panels, and remote control switching relays.
- E. Section 26 2726 - Wiring Devices: Devices for manual control of lighting, including wall switches, wall dimmers, and fan speed controllers.
 - 1. Includes finish requirements for wall controls specified in this section.
 - 2. Includes accessory receptacles, switches, dimmers and wall plates, to match lighting controls specified in this section.
- F. Section 26 5600 - Exterior Lighting.

1.03 REFERENCE STANDARDS

- A. ANSI C136.10 - American National Standard for Roadway and Area Lighting Equipment - Locking-Type Photocontrol Devices and Mating Receptacles - Physical and Electrical Interchangeability and Testing; 2010.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2010.
- C. NECA 130 - Standard for Installing and Maintaining Wiring Devices; National Electrical Contractors Association; 2010.
- D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); National Electrical Manufacturers Association; 2014.
- E. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. UL 773 - Plug-in Locking Type Photocontrols for Use with Area Lighting; Current Edition, Including All Revisions.
- G. UL 773A - Nonindustrial Photoelectric Switches for Lighting Control; Current Edition, Including All Revisions.
- H. UL 916 - Energy Management Equipment; Current Edition, Including All Revisions.
- I. UL 917 - Clock-Operated Switches; Current Edition, Including All Revisions.
- J. UL 1472 - Solid-State Dimming Controls; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the placement of lighting control devices with millwork, furniture, equipment, etc. installed under other sections or by others.
 - 2. Coordinate the placement of wall switch occupancy sensors with actual installed door swings.

3. Coordinate the placement of occupancy sensors with millwork, furniture, equipment or other potential obstructions to motion detection coverage installed under other sections or by others.
4. Coordinate the placement of photo sensors for daylighting controls with windows, skylights, and luminaires to achieve optimum operation. Coordinate placement with ductwork, piping, equipment, or other potential obstructions to light level measurement installed under other sections or by others.
5. Notify Architect of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements and 26 0200 - Basic Electrical Requirements, for submittal procedures.
- B. Prior Approval: If products from other than the named manufacturer are submitted in consideration for inclusion within the project, all of the following requirements must be met. Failure to meet any one of the following requirements will constitute failure to comply with the project requirements and the submitted package will not be considered for inclusion.
 1. Specifications Compliance: Submit a line-by-line comparison that describes the differences between each specifications requirement and the equipment / systems being proposed. Comparison shall include a complete listing of how the proposed equipment / systems differ from that specified with regard to size, quantity, quality, method of control, features and functions, control software functions and installation requirements.
 2. System Description: Supply as part of the submittal package a brief description of the lighting control system's major features and functions.
 3. Bill of Materials: Provide as part of the submittal package a detailed itemized listing, using the Engineer's project naming convention, of all proposed equipment, including quantities and capacities for all major system components.
 4. Product Data Sheets: Provide as part of the submittal package, detailed product data sheets, using the engineer's project naming convention, providing one individual product data sheet per each specified component, for all major system components.
 5. Warranty: Provide as part of the submittal package a complete written warranty.
 6. One-Line Diagram: Provide a one-line diagram showing all relay lighting control panels and devices connected to the lighting control system such as master relay panel, satellite relay panel(s), digital time clock, low voltage switches, bus boosters, network connectors, typical interconnection diagrams, etc.
 7. Lighting Controls Layouts: Provide lighting controls equipment and device layouts in *.pdf format, on the Architect's most current ceiling plans, using the same scale and text height as the engineering ceiling plans, for all spaces with location and

model number of each device and system component clearly indicated in all spaces for evaluation of conformance to the design intent by the Engineer.

- C. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on construction, dimensions, ratings, finishes, features, mounting requirements, listings, service condition requirements, installed accessories, and standard wiring diagrams; include model number nomenclature clearly marked with all proposed features. Provide separate product data information for each lighting control device indicated using Engineer's project naming convention.
 - 1. Provide submittals for this Section concurrently with Sections 26 0918, 26 5100 and 26 5600.
 - 2. Arrange in order of device designation.
- D. One-Line Diagram: Provide a one-line diagram showing all relay lighting control panels and devices connected to the lighting control system such as master relay panel, satellite relay panel(s), digital time clock, low voltage switches, bus boosters, network connectors, typical interconnection diagrams, etc.
- E. Lighting Controls Layouts: Provide lighting controls equipment and device layouts in *.pdf format, on the Architect's most current ceiling plans, using the same scale and text height as the engineering ceiling plans, for all spaces with location and model number of each device and system component clearly indicated in all spaces.
- F. Operation and Maintenance Data: Include detailed information on device programming and setup.
- G. Project Record Documents: Record actual installed locations and settings for lighting control devices.

1.06 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.07 DELIVERY, STORAGE, AND PROTECTION

- A. Store products in a clean, dry space in original manufacturer's packaging in accordance with manufacturer's written instructions until ready for installation.

1.08 FIELD CONDITIONS

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.09 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year manufacturer warranty for utility grade locking receptacle-mounted outdoor photo controls.

PART 2 PRODUCTS

2.01 LIGHTING CONTROL DEVICES - GENERAL REQUIREMENTS

- A. Provide products listed, classified, and labeled as suitable for the purpose intended.
- B. Unless specifically indicated to be excluded, provide all required conduit, wiring, connectors, hardware, components, accessories, etc. as required for a complete operating system.

2.02 OUTDOOR PHOTO CONTROLS

- A. Manufacturers:
 - 1. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.
- B. Stem-Mounted Outdoor Photo Controls:
 - 1. Description: Direct-wired photo control unit with threaded conduit mounting stem and field-adjustable swivel base, listed and labeled as complying with UL 773A.
 - 2. Housing: Weatherproof, impact resistant polycarbonate.

3. Photo Sensor: Cadmium sulfide.
4. Provide external sliding shield for field adjustment of light level activation.
5. Light Level Activation: 1 to 5 footcandles turn-on and 3 to 1 turn-off to turn-on ratio with delayed turn-off.
6. Voltage: As required to control the load indicated on the drawings.
7. Failure Mode: Fails to the on position.
8. Load Rating: As required to control the load indicated on the drawings.
9. Provide accessory wall-mounting bracket where indicated or as required to complete installation.

C. Locking Receptacle-Mounted Outdoor Photo Controls

1. Description: Plug-in locking type photo control unit complying with ANSI C136.10 for mounting on a compatible receptacle, listed and labeled as complying with UL 773.
2. Housing: Weatherproof, impact resistant UV stabilized polypropylene, color to be selected.
3. Photo Sensor: Cadmium sulfide.
4. Light Level Activation: 1 to 3 footcandles turn-on and 1.5 to 1 turn-off to turn-on ratio with instant turn-on and delayed turn-off.
5. Voltage: As required to control the load indicated on the drawings.
6. Failure Mode: Fails to the on position.
7. Load Rating: As required to control the load indicated on the drawings.
8. Surge Protection: 160 joule metal oxide varistor.
9. Provide the following accessories where indicated or as required to complete installation:
 - a. Receptacle: Complying with ANSI C136.10.
 - b. Mounting Bracket.
 - c. Shorting Cap: Suitable for replacing locking photo control to complete circuit.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.
- C. Verify that openings for outlet boxes are neatly cut and will be completely covered by devices or wall plates.
- D. Verify that final surface finishes are complete.

- E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to lighting control devices.
- F. Verify that the service voltage and ratings of lighting control devices are appropriate for the service voltage and load requirements at the location to be installed.
- G. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

- A. Perform work in a neat and workmanlike manner in accordance with NECA 1 and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.
- B. Coordinate locations of outlet boxes provided under Section 26 0537 as required for installation of lighting control devices provided under this section.
 - 1. Mounting Heights: as indicated in Section 26 2726.
 - 2. Orient outlet boxes for vertical installation of lighting control devices unless otherwise indicated.
- C. Install lighting control devices in accordance with manufacturer's instructions.
- D. Unless otherwise indicated, connect lighting control device grounding terminal or conductor to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
- E. Install lighting control devices plumb and level, and held securely in place.
- F. Where required and not furnished with lighting control device, provide wall plate in accordance with Section 26 2726.

- G. Where applicable, install lighting control devices and associated wall plates to fit completely flush to mounting surface with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.
- H. Identify lighting control devices in accordance with Section 26 0553.
- I. Outdoor Photo Control Locations:
 - 1. Where possible, locate outdoor photo controls with photo sensor facing north. If north facing photo sensor is not possible, install with photo sensor facing east, west, or down.
 - 2. Locate outdoor photo controls so that photo sensors do not face artificial light sources, including light sources controlled by the photo control itself.
- J. Install outdoor photo controls so that connections are weatherproof. Do not install photo controls with conduit stem facing up in order to prevent infiltration of water into the photo control.
- K. Daylighting Control Photo Sensor Locations:
- L. Lamp Burn-In: Operate lamps at full output for minimum of 100 hours or prescribed period per manufacturer's recommendations prior to use with any dimming controls. Replace lamps that fail prematurely due to improper lamp burn-in.
- M. Unless otherwise indicated, install power packs for lighting control devices above accessible ceiling or above access panel in inaccessible ceiling near the sensor location.
- N. Where indicated, install separate compatible wall switches for manual control interface with lighting control devices or associated power packs.
- O. Unless otherwise indicated, install switches on load side of power packs so that switch does not turn off power pack.
- P. Where indicated or required, provide cabinet or enclosure in accordance with Section 26 0537 for mounting of lighting control device system components.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Inspect each lighting control device for damage and defects.
- C. Test occupancy sensors to verify proper operation, including time delays and ambient light thresholds where applicable. Verify optimal coverage for entire room or area. Record test results in written report to be included with submittals.
- D. Test time switches to verify proper operation.
- E. Test outdoor photo controls to verify proper operation, including time delays where applicable.
- F. Test daylighting controls to verify proper operation, including light level measurements and time delays where applicable. Record test results in written report to be included with submittals.
- G. Correct wiring deficiencies and replace damaged or defective lighting control devices.

3.05 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.
- B. Adjust occupancy sensor settings to minimize undesired activations while optimizing energy savings, and to achieve desired function as indicated or as directed by Architect.
- C. Adjust position of directional occupancy sensors and outdoor motion sensors to achieve optimal coverage as required.
- D. Where indicated or as directed by Architect, install factory masking material or adjust integral blinders on passive infrared (PIR) and dual technology occupancy sensor lenses to block undesired motion detection.
- E. Adjust time switch settings to achieve desired operation schedule as indicated or as directed by Architect. Record settings in written report to be included with submittals.

- F. Adjust external sliding shields on outdoor photo controls under optimum lighting conditions to achieve desired turn-on and turn-off activation as indicated or as directed by Architect.

3.06 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.07 CLOSEOUT ACTIVITIES

- A. See Section 01 7800 - Closeout Submittals, for closeout submittals.
- B. See Section 01 7900 - Demonstration and Training, for additional requirements.
- C. Demonstration: Demonstrate proper operation of lighting control devices to Architect, and correct deficiencies or make adjustments as directed.
- D. Training: Train Owner's personnel on operation, adjustment, programming, and maintenance of lighting control devices.
 - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
 - 2. Instructor: Qualified contractor familiar with the project and with sufficient knowledge of the installed lighting control devices.
 - 3. Location: At project site.

END OF SECTION 26 09 23

SECTION 26 24 16 - PANELBOARDS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Lighting and appliance branch-circuit panelboards.
 - 2. Electronic-grade panelboards.

1.03 DEFINITIONS

- A. SVR: Suppressed voltage rating.
- B. TVSS: Transient voltage surge suppressor.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
 - 3. Detail bus configuration, current, and voltage ratings.
 - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
 - 5. Include evidence of NRTL listing for series rating of installed devices.
 - 6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 7. Include wiring diagrams for power, signal, and control wiring.
 - 8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on

translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

1.05 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.
- B. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

1.06 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:
 - 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 - 2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.07 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Keys: Two spares for each type of panelboard cabinet lock.
 - 2. Circuit Breakers Including GFCI and Ground Fault Equipment Protection (GFEP) Types: Two spares for each panelboard.
 - 3. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.08 QUALITY ASSURANCE

- A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

- D. Comply with NEMA PB 1.
- E. Comply with NFPA 70.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.
- B. Handle and prepare panelboards for installation according to NEMA PB 1.

1.10 PROJECT CONDITIONS

- A. Environmental Limitations:
 - 1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
 - 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Not exceeding 23 deg. F to plus 104 deg. F.
 - b. Altitude: Not exceeding 6600 feet.
- B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
 - 1. Ambient temperatures within limits specified.
 - 2. Altitude not exceeding 6600 feet.
- C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 - 1. Notify Architect no fewer than two days in advance of proposed interruption of electric service.
 - 2. Do not proceed with interruption of electric service without Owner's written permission.
 - 3. Comply with NFPA 70E.

1.11 COORDINATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and

other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

1.12 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.

- 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Enclosures: Surface-mounted cabinets.
 - 1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
 - 2. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
 - 3. Finishes:
 - a. Panels and Trim: Steel and galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
 - b. Back Boxes: Same finish as panels and trim.
 - 4. Directory Card: Inside panelboard door, mounted in metal frame with transparent protective cover.
- B. Incoming Mains Location: Top and bottom.
- C. Phase, Neutral, and Ground Buses:
 - 1. Material: Copper.
 - 2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.

- D. Conductor Connectors: Suitable for use with conductor material and sizes.
 - 1. Material: Copper.
 - 2. Main and Neutral Lugs: Mechanical type.
 - 3. Ground Lugs and Bus-Configured Terminators: Mechanical type.
- E. Service Equipment Label: NRTL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.
- F. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- G. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.02 PERFORMANCE REQUIREMENTS

- A. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD Type 2.

2.03 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:
 - 1. General Electric Company: GE Industrial
 - 2. Square D – Schneider Electric
 - 3. Eaton
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: Circuit breaker.
- D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- E. Contactors in Main Bus: NEMA ICS 2, Class A, mechanically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.
 - 1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.
- F. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.
- G. Column-Type Panelboards: Narrow gutter extension, with cover, to overhead junction box equipped with ground and neutral terminal buses.

2.04 ELECTRONIC-GRADE PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:
 - 1. General Electric Company, GE Industrial
 - 2. Square D- Schneider Electric
- B. Panelboards: NEMA PB 1; with factory-installed, integral TVSS; labeled by an NRTL for compliance with UL 67 after installing TVSS.
- C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
- D. Main Overcurrent Protective Devices: Bolt-on thermal-magnetic circuit breakers.
- E. Branch Overcurrent Protective Devices: Bolt-on thermal-magnetic circuit breakers.
- F. Buses:
 - 1. Copper phase and neutral buses; 200 percent capacity neutral bus and lugs.
 - 2. Copper equipment and isolated ground buses.

2.05 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - 2. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
 - 3. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
 - 4. GFCI Circuit Breakers: Single and double-pole configurations with Class A ground-fault protection (6-mA trip).
 - 5. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.

2.06 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
- B. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.
- B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install panelboards and accessories according to NECA 407 NEMA PB 1.1.
- B. Equipment Mounting: Install vertical panelboards to vertical wall surfaces.
 - 1. Attach panelboard to the vertical finished or structural surface behind the panelboard.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
- D. Mount top of trim 90 inches above finished floor unless otherwise indicated.
- E. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- F. Install overcurrent protective devices and controllers not already factory installed.
- G. Install filler plates in unused spaces.

- H. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.
- I. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.
- J. Comply with NECA 1.

3.03 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 26 05 53 "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.04 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- C. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 3. Perform the following infrared scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
 - c. Instruments and Equipment:
 - 1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
- D. Panelboards will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.05 ADJUSTING

- A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.
- B. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.
 1. Measure as directed during period of normal system loading.
 2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
 3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
 4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

3.06 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 26 24 16

SECTION 26 27 13 - ELECTRICITY METERING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section includes equipment for electricity metering by utility company.

1.03 ACTION SUBMITTALS

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

1.04 QUALITY ASSURANCE

- A. 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.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Receive, store, and handle modular meter center according to NECA 400.

1.06 COORDINATION

- A. Electrical Service Connections: Coordinate with utility companies and components they furnish as follows:
 - 1. Comply with requirements of utilities providing electrical power services.
 - 2. Coordinate installation and connection of utilities and services, including provision for electricity-metering components.

PART 2 - PRODUCTS

2.01 EQUIPMENT FOR ELECTRICITY METERING BY UTILITY COMPANY

- A. Meters will be furnished by utility company.
- B. Current-Transformer Cabinets: Comply with requirements of electrical-power utility company.
- C. Meter Sockets: Comply with requirements of electrical-power utility company.
 - 1. Meter Socket: Rating coordinated with indicated tenant feeder circuit rating.
 - 2. Surge Protection: For main disconnect device, comply with requirements in Section 26 43 13 "Surge Protection for Low-Voltage Electrical Power Circuits."

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Comply with equipment installation requirements in NECA 1.
- B. Install meters furnished by utility company. Install raceways and equipment according to utility company's written requirements. Provide empty conduits for metering leads and extend grounding connections as required by utility company.
- C. Install modular meter center according to NECA 400 switchboard installation requirements.

3.02 IDENTIFICATION

- A. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."
 - 1. Series Combination Warning Label: Self-adhesive type, with text as required by NFPA 70.
 - 2. Equipment Identification Labels: Adhesive film labels with clear protective overlay. Provide an additional card holder suitable for printed, weather-resistant card with occupant's name.

END OF SECTION 26 27 13

SECTION 26 27 26 - WIRING DEVICES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Receptacles, receptacles with integral GFCI, and associated device plates.
 - 2. Weather-resistant receptacles.
 - 3. Snap switches and wall-box dimmers.
 - 4. Solid-state fan speed controls.
 - 5. Communications outlets.
 - 6. Pendant cord-connector devices.

1.03 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- D. RFI: Radio-frequency interference.
- E. UTP: Unshielded twisted pair.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Receptacles for Owner-Furnished Equipment: Match plug configurations.

1.05 ACTION SUBMITTALS

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

1.06 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.07 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
 - 1. Hubbell, Leviton, Pass & Seymour
- B. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.02 GENERAL WIRING-DEVICE REQUIREMENTS

- A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.
- C. All devices to be Decora Style.
- D. Apparatus Bay and Support Areas – all switch and outlet cover plates to be stainless steel.
- E. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:
 - 1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
 - 2. Devices shall comply with the requirements in this Section.

2.03 STRAIGHT-BLADE RECEPTACLES

- A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.

2.04 GFCI RECEPTACLES

- A. General Description:
 - 1. Straight blade, feed-through type.
 - 2. Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 943 Class A, and FS W-C-596.
 - 3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.

2.05 PENDANT CORD-CONNECTOR DEVICES

- A. Description:
 - 1. Matching, locking-type plug and receptacle body connector.
 - 2. NEMA WD 6 Configurations L5-20P and L5-20R, heavy-duty grade, and FS W-C-596.
 - 3. Body: Nylon, with screw-open, cable-gripping jaws and provision for attaching external cable grip.
 - 4. External Cable Grip: Woven wire-mesh type made of high-strength, galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

2.06 RESIDENTIAL DEVICES

- A. General: All devices to be Decora Style.
- B. Residential-Grade, Tamper-Resistant Convenience Receptacles, 125 V, 15 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, and UL 498.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cooper; TR270.
 - b. Hubbell; RR155TR.
 - c. Leviton; T5320.
 - d. Pass & Seymour; TR62.

2. Description: Labeled to comply with NFPA 70, "Receptacles, Cord Connectors, and Attachment Plugs (Caps)" Article, "Tamper-Resistant Receptacles in Dwelling Units" Section.

2.07 WALL PLATES

- A. Single and combination types shall match corresponding wiring devices.
 1. Plate-Securing Screws: Metal with head color to match plate finish.
 2. Material for Finished Spaces: Smooth, high-impact thermoplastic.
 3. Material for Unfinished Spaces: Smooth, high-impact thermoplastic.
 4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.
 5. Material for Apparatus Bay and support areas: stainless steel.
 6. Material for Kitchen Backsplash Areas: Stainless Steel.
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.
 1. In-Use Weathertight Cover.

2.08 FINISHES

- A. Device Color:
 1. Wiring Devices Connected to Normal Power System: White unless otherwise indicated or required by NFPA 70 or device listing.
 2. Isolated-Ground Receptacles: Orange.
- B. Wall Plate Color: For plastic covers: White.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.
- B. Coordination with Other Trades:
 1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.

2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:
 - a. Cut back and pigtail, or replace all damaged conductors.
 - b. Straighten conductors that remain and remove corrosion and foreign matter.
 - c. Pigtailing existing conductors is permitted, provided the outlet box is large enough.

D. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the left.
- F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.
- G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multi-gang wall plates.

3.02 GFCI RECEPTACLES

- A. Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

3.03 IDENTIFICATION

- A. Comply with Section 26 05 53 "Identification for Electrical Systems."
- B. Identify each receptacle and switch with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.04 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
1. In healthcare facilities, prepare reports that comply with recommendations in NFPA 99.
 2. Test Instruments: Use instruments that comply with UL 1436.
 3. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
- B. Tests for Convenience Receptacles:
1. Line Voltage: Acceptable range is 105 to 132 V.
 2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
 3. Ground Impedance: Values of up to 2 ohms are acceptable.
 4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
 5. Using the test plug, verify that the device and its outlet box are securely mounted.
 6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove

malfunctioning units and replace with new ones, and retest as specified above.

- C. Test straight-blade convenience outlets in patient-care areas for the retention force of the grounding blade according to NFPA 99. Retention force shall be not less than 4 OZ..
- D. Wiring device will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

END OF SECTION 26 27 26

SECTION 26 32 13 - GASEOUS ENGINE GENERATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes packaged engine generators for non-emergency use with the following features:
 - 1. Natural Gas engine.
 - 2. Liquid Propane fuel source backup.
 - 3. Gaseous fuel system.
 - 4. Control and monitoring.
 - 5. Generator overcurrent and fault protection.
 - 6. Generator, exciter, and voltage regulator.
 - 7. Outdoor generator-set enclosure.
 - 8. Remote radiator motors.
 - 9. Vibration isolation devices.
 - 10. Finishes.
- B. Related Requirements:
 - 1. Section 26 23 13 "Paralleling Low-Voltage Switchgear" for controls and paralleling equipment for large or multiple parallel engine generators.
 - 2. Section 26 36 00 "Transfer Switches" for transfer switches including sensors and relays to initiate automatic-starting and -stopping signals for engine generators.

1.3 DEFINITIONS

- A. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.
- B. NG: Natural Gas
- C. LP: Liquid Propane Gas

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
 - 2. Include thermal damage curve for generator.
 - 3. Include time-current characteristic curves for generator protective device.
 - 4. Include fuel consumption in cubic feet per hour (cubic meters per hour) at 0.8 power factor at 0.5, 0.75 and 1.0 times generator capacity.
 - 5. Include generator efficiency at 0.8 power factor at 0.5, 0.75, and 1.0 times generator capacity.
 - 6. Include air flow requirements for cooling and combustion air in cfm at 0.8 power factor, with air supply temperature of 95 deg F, 80 deg F, 70 deg F, and 50 deg F. Provide drawings showing requirements and limitations for location of air intake and exhausts.
 - 7. Include generator characteristics, including, but not limited to, kilowatt rating, efficiency, reactances, and short-circuit current capability.
- B. Shop Drawings:
 - 1. Include plans and elevations for engine generator and other components specified.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Identify fluid drain ports and clearance requirements for proper fluid drain.
 - 4. Design calculations for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
 - 5. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include base weights.
 - 6. Include diagrams for power, signal, and control wiring. Complete schematic, wiring, and interconnection diagrams showing terminal markings for EPS equipment and functional relationship between all electrical components.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer and testing agency.
- B. Source Quality-Control Reports: Including, but not limited to, the following:
 - 1. Certified summary of prototype-unit test report.
 - 2. Certified Test Reports: For components and accessories that are equivalent, but not identical, to those tested on prototype unit.
 - 3. Certified Summary of Performance Tests: Certify compliance with specified requirement to meet performance criteria for sensitive loads.

4. Report of factory test on units to be shipped for this Project, showing evidence of compliance with specified requirements.
 5. Report of sound generation.
 6. Report of exhaust emissions showing compliance with applicable regulations.
- C. Field quality-control reports.
- D. Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For engine generators to include in emergency, operation, and maintenance manuals.
1. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:
 - a. List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.
 - b. Operating instructions laminated and mounted adjacent to generator location.
 - c. Training plan.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Fuses: One for every 10 of each type and rating, but no fewer than one of each.
 2. Indicator Lamps: Two for every six of each type used, but no fewer than two of each.
 3. Filters: One set each of lubricating oil, fuel, and combustion-air filters.
 4. Tools: Each tool listed by part number in operations and maintenance manual.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
- B. Testing Agency Qualifications: Accredited by NETA.
1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.9 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: 5 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Caterpillar, Inc.; Electric Power Division.
 - 2. Cummins Power Generation.
 - 3. Kohler Power Systems.
- B. Source Limitations: Obtain packaged engine generators and auxiliary components through one source from a single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. B11 Compliance: Comply with B11.19.
- B. NFPA Compliance:
 - 1. Comply with NFPA 37.
 - 2. Comply with NFPA 70.
- C. UL Compliance: Comply with UL 2200.
- D. Engine Exhaust Emissions: Comply with EPA Tier 4 requirements and applicable state and local government requirements.
- E. Environmental Conditions: Engine generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
 - 1. Ambient Temperature: 5 to 104 deg F.
 - 2. Relative Humidity: Zero to 95 percent.
 - 3. Altitude: Sea level to 500.

2.3 ENGINE GENERATOR ASSEMBLY DESCRIPTION

- A. Factory-assembled and -tested, water-cooled engine, with brushless generator and accessories.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency acceptable to authorities having jurisdiction, and marked for intended location and use.
- C. Power Rating: Prime.
- D. Overload Capacity: 110 percent of service load for 1 hour in 12 consecutive hours.
- E. Service Load: Refer to Electrical One-Line Diagram for size.
- F. Power Factor: 0.8, lagging.
- G. Frequency: 60 Hz
- H. Voltage: 208 V ac.
- I. Phase: Three-phase, four wire, wye.
- J. Induction Method: Naturally aspirated.
- K. Governor: Adjustable isochronous, with speed sensing.
- L. Mounting Frame: Structural steel framework to maintain alignment of mounted components without depending on concrete foundation. Provide lifting attachments sized and spaced to prevent deflection of base during lifting and moving.
 - 1. Rigging Diagram: Inscribed on metal plate permanently attached to mounting frame to indicate location and lifting capacity of each lifting attachment and generator-set center of gravity.
- M. Capacities and Characteristics:
 - 1. Power Output Ratings: Nominal ratings as indicated at 0.8 power factor excluding power required for the continued and repeated operation of the unit and auxiliaries.
 - 2. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.
- N. Engine Generator Performance:
 - 1. Steady-State Voltage Operational Bandwidth: 3 percent of rated output voltage from no load to full load.
 - 2. Transient Voltage Performance: Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within three seconds.

3. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.
4. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
5. Transient Frequency Performance: Less than 5 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within five seconds.
6. Output Waveform: At no load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for single harmonics. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
7. Sustained Short-Circuit Current: For a three-phase, bolted short circuit at system output terminals, system shall supply a minimum of 250 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to generator system components.
8. Start Time: 10 seconds.

O. Engine Generator Performance for Sensitive Loads:

1. Oversizing generator compared with the rated power output of the engine is permissible to meet specified performance.
 - a. Nameplate Data for Oversized Generator: Show ratings required by the Contract Documents rather than ratings that would normally be applied to generator size installed.
2. Steady-State Voltage Operational Bandwidth: 1 percent of rated output voltage from no load to full load.
3. Transient Voltage Performance: Not more than 10 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within 0.5 second.
4. Steady-State Frequency Operational Bandwidth: Plus or minus 0.25 percent of rated frequency from no load to full load.
5. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
6. Transient Frequency Performance: Less than 2-Hz variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within three seconds.
7. Output Waveform: At no load, harmonic content measured line to neutral shall not exceed 2 percent total with no slot ripple. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
8. Sustained Short-Circuit Current: For a three-phase, bolted short circuit at system output terminals, system shall supply a minimum of 300 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to winding insulation or other generator system components.

9. Excitation System: Performance shall be unaffected by voltage distortion caused by nonlinear load.
 - a. Provide permanent magnet excitation for power source to voltage regulator.
10. Start Time: 10 seconds.

2.4 GASEOUS ENGINE

- A. Fuel: NG – Natural Gas.
- B. Liquid Propane (LP) fuel source backup / engine swithover.
- C. Rated Engine Speed: 1800 rpm.
- D. Lubrication System: Engine or skid-mounted.
 1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
 2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
 3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.
- E. Jacket Coolant Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with UL 499.
- F. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine generator mounting frame and integral engine-driven coolant pump.
 1. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
 2. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
 3. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.
 4. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
 5. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, ultraviolet-, and abrasion-resistant fabric.
 - a. Rating: 50-psig maximum working pressure with coolant at 180 deg F, and noncollapsible under vacuum.

- b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.
- G. Muffler/Silencer: Commercial type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.
 - 1. Minimum sound attenuation of 12 dB at 500 Hz.
 - 2. Sound level measured at a distance of 25 feet from exhaust discharge after installation is complete shall be 90 dBA or less.
- H. Air-Intake Filter: Heavy-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.
- I. Starting System: 24-V electric, with negative ground.
 - 1. Components: Sized so they are not damaged during a full engine-cranking cycle with ambient temperature at maximum specified in "Performance Requirements" Article.
 - 2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
 - 3. Cranking Cycle: 60 seconds.
 - 4. Battery: Nickel cadmium, with capacity within ambient temperature range specified in "Performance Requirements" Article to provide specified cranking cycle at least three times without recharging.
 - 5. Battery Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.
 - 6. Battery Compartment: Factory fabricated of metal with acid-resistant finish and thermal insulation. Thermostatically controlled heater shall be arranged to maintain battery above 50 deg F regardless of external ambient temperature within range specified in "Performance Requirements" Article. Include accessories required to support and fasten batteries in place. Provide ventilation to exhaust battery gases.
 - 7. Battery Stand: Factory-fabricated, two-tier metal with acid-resistant finish designed to hold the quantity of battery cells required and to maintain the arrangement to minimize lengths of battery interconnections.
 - 8. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35 A minimum continuous rating.
 - 9. Battery Charger: Current-limiting, automatic-equalizing and float-charging type designed for nickel cadmium batteries. Unit shall comply with UL 1236 and include the following features:
 - a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.

- b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 deg F to 140 deg F to prevent overcharging at high temperatures and undercharging at low temperatures.
- c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
- d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.
- e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
- f. Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet.

2.5 GASEOUS FUEL SYSTEM

- A. Natural Gas Piping: Comply with requirements in Section 23 11 23 "Facility Natural Gas Piping."
- B. Gas Train: Comply with NFPA 37.
- C. Engine Fuel System:
- D. Natural Gas / Liquid Propane, Vapor-Withdrawal System:
 - 1. Carburetor.
 - 2. Secondary Gas Regulators: One for each fuel type, with atmospheric vents piped to building exterior.
 - 3. Fuel-Shutoff Solenoid Valves: NRTL-listed, normally closed, safety shutoff valves; one for each fuel source.
 - 4. Fuel Filters: One for each fuel type.
 - 5. Manual Fuel Shutoff Valves: One for each fuel type.
 - 6. Flexible Fuel Connectors: Minimum one for each fuel connection.

2.6 CONTROL AND MONITORING

- A. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of engine generator. When mode-selector switch is switched to the on position, engine generator starts. The off position of same switch initiates generator-set shutdown. When engine generator is running, specified system or equipment failures or derangements automatically shut down engine generator and initiate alarms.

- B. Provide minimum run time control set for 15 minutes with override only by operation of a remote emergency-stop switch.
- C. Comply with UL 508A.
- D. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common control and monitoring panel mounted on the engine generator. Mounting method shall isolate the control panel from generator-set vibration. Panel shall be powered from the engine generator battery.
- E. Control and Monitoring Panel:
 - 1. Digital controller with integrated LCD, controls, and microprocessor, capable of local and remote control, monitoring, and programming, with battery backup.
 - 2. Analog control panel with dedicated gages and indicator lights for the instruments and alarms indicated below.
 - 3. Instruments: Located on the control and monitoring panel and viewable during operation.
 - a. Engine lubricating-oil pressure gage.
 - b. Engine-coolant temperature gage.
 - c. DC voltmeter (alternator battery charging).
 - d. Running-time meter.
 - e. AC voltmeter, for each phase connected to a phase selector switch.
 - f. AC ammeter, for each phase connected to a phase selector switch.
 - g. AC frequency meter.
 - h. Generator-voltage adjusting rheostat.
 - 4. Controls and Protective Devices: Controls, shutdown devices, and common visual alarm indication, including the following:
 - a. Cranking control equipment.
 - b. Run-Off-Auto switch.
 - c. Control switch not in automatic position alarm.
 - d. Overcrank alarm.
 - e. Overcrank shutdown device.
 - f. Low water temperature alarm.
 - g. High engine temperature prealarm.
 - h. High engine temperature.
 - i. High engine temperature shutdown device.
 - j. Overspeed alarm.
 - k. Overspeed shutdown device.
 - l. Low fuel main tank.
 - m. Coolant low-level alarm.
 - n. Coolant low-level shutdown device.
 - o. Coolant high-temperature prealarm.
 - p. Coolant high-temperature alarm.
 - q. Coolant low-temperature alarm.
 - r. Coolant high-temperature shutdown device.

- s. EPS supplying load indicator.
- t. Battery high-voltage alarm.
- u. Low cranking voltage alarm.
- v. Battery-charger malfunction alarm.
- w. Battery low-voltage alarm.
- x. Lamp test.
- y. Contacts for local and remote common alarm.
- z. Low-starting air pressure alarm.
- aa. Low-starting hydraulic pressure alarm.
- bb. Remote manual stop shutdown device.
- cc. Air shutdown damper alarm when used.
- dd. Air shutdown damper shutdown device when used.
- ee. Hours of operation.
- ff. Engine generator metering, including voltage, current, Hz, kW, kVA, and power factor.
- gg. Generator overcurrent protective device not closed alarm.

F. Engine Generator Metering: Comply with

G. Connection to Datalink:

- 1. A separate terminal block, factory wired to Form C dry contacts, for each alarm and status indication.
- 2. Provide connections for datalink transmission of indications to remote data terminals via Ethernet. Data system connections to terminals are covered in Section 26 09 13 "Electrical Power Monitoring and Control."

H. Common Remote Panel with Common Audible Alarm: Include necessary contacts and terminals in control and monitoring panel. Remote panel shall be powered from the engine generator battery.

I. Remote Alarm Annunciator: An LED indicator light labeled with proper alarm conditions shall identify each alarm event, and a common audible signal shall sound for each alarm condition. Silencing switch in face of panel shall silence signal without altering visual indication. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset. Cabinet and faceplate are surface- or flush-mounting type to suit mounting conditions indicated.

- 1. Overcrank alarm.
- 2. Coolant low-temperature alarm.
- 3. High engine temperature prealarm.
- 4. High engine temperature alarm.
- 5. Low lube oil pressure alarm.
- 6. Overspeed alarm.
- 7. Low fuel main tank alarm.
- 8. Low coolant level alarm.
- 9. Low cranking voltage alarm.

10. Contacts for local and remote common alarm.
 11. Audible-alarm silencing switch.
 12. Air shutdown damper when used.
 13. Run-Off-Auto switch.
 14. Control switch not in automatic position alarm.
 15. Fuel tank derangement alarm.
 16. Fuel tank high-level shutdown of fuel supply alarm.
 17. Lamp test.
 18. Low cranking voltage alarm.
 19. Generator overcurrent protective device not closed.
- J. Remote Emergency-Stop Switch: Flush; wall mounted, unless otherwise indicated; and labeled. Push button shall be protected from accidental operation.
- K. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.

2.7 GENERATOR OVERCURRENT AND FAULT PROTECTION

- A. Generator Circuit Breaker: Molded-case, thermal-magnetic type; 100 percent rated; complying with UL 489.
1. Tripping Characteristic: Designed specifically for generator protection.
 2. Trip Rating: Matched to generator output rating.
 3. Shunt Trip: Connected to trip breaker when engine generator is shut down by other protective devices.
 4. Mounting: Adjacent to or integrated with control and monitoring panel.
- B. Generator Protector: Microprocessor-based unit shall continuously monitor current level in each phase of generator output, integrate generator heating effect over time, and predict when thermal damage of alternator will occur. When signaled by generator protector or other generator-set protective devices, a shunt-trip device in the generator disconnect switch shall open the switch to disconnect the generator from load circuits. Protector performs the following functions:
1. Initiates a generator overload alarm when generator has operated at an overload equivalent to 110 percent of full-rated load for 60 seconds. Indication for this alarm is integrated with other generator-set malfunction alarms. Contacts shall be available for load shed functions.
 2. Under single or three-phase fault conditions, regulates generator to 300 percent of rated full-load current for up to 10 seconds.
 3. As overcurrent heating effect on the generator approaches the thermal damage point of the unit, protector switches the excitation system off, opens the generator disconnect device, and shuts down the engine generator.
 4. Senses clearing of a fault by other overcurrent devices and controls recovery of rated voltage to avoid overshoot.

2.8 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

- A. Comply with NEMA MG 1.
- B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.
- C. Electrical Insulation: Class H.
- D. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required. Provide 12 lead alternator.
- E. Range: Provide extended range of output voltage by adjusting the excitation level.
- F. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.
- G. Enclosure: Drip proof.
- H. Instrument Transformers: Mounted within generator enclosure.
- I. Voltage Regulator: Solid-state type, separate from exciter.
 - 1. Adjusting Rheostat on Control and Monitoring Panel: Provide plus or minus 5 percent adjustment of output-voltage operating band.
 - 2. Maintain voltage within 20 percent on one step, full load.
 - 3. Provide anti-hunt provision to stabilize voltage.
 - 4. Maintain frequency within 5 percent and stabilize at rated frequency within 2 seconds.
- J. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.
- K. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.
- L. Subtransient Reactance: 12 percent, maximum.

2.9 OUTDOOR GENERATOR-SET ENCLOSURE

- A. Description: Vandal-resistant, sound-attenuating, weatherproof steel housing, wind resistant up to 110 mph. Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Panels shall be removable by one person without tools. Instruments and control shall be mounted within enclosure.
 - 1. Sound Attenuation Level: standard.
- B. Description: Prefabricated or pre-engineered galvanized-steel-clad, integral structural-steel-framed, walk-in enclosure, erected on concrete foundation.

- C. Structural Design and Anchorage: Comply with ASCE/SEI 7 for wind loads up to 100 mph.
- D. Seismic Design: Comply with seismic requirements in Section 26 05 48.16 "Seismic Controls for Electrical Systems."
- E. Fire Protection: Provide fire protection in accordance with Provide smoke detector in enclosure; mounted according to NFPA 72.
- F. Hinged Doors: With padlocking provisions.
- G. Space Heater: Thermostatically controlled and sized to prevent condensation.
- H. Lighting: Provide weather-resistant LED lighting with 30 fc average maintained.
- I. Thermal Insulation: Manufacturer's standard materials and thickness selected in coordination with space heater to maintain winter interior temperature within operating limits required by engine generator components.
- J. Muffler Location: External to enclosure.
- K. Engine Cooling Airflow through Enclosure: Maintain temperature rise of system components within required limits when unit operates at 110 percent of rated load for 2 hours with ambient temperature at top of range specified in system service conditions.
 - 1. Louvers: Fixed-engine, cooling-air inlet and discharge. Storm-proof and drainable louvers prevent entry of rain and snow.
 - 2. Ventilation: Provide temperature-controlled exhaust fan interlocked to prevent operation when engine is running.
- L. Interior Lights with Switch: Factory-wired, vapor-proof fixtures within housing; arranged to illuminate controls and accessible interior. Arrange for external electrical connection.
 - 1. AC lighting system and connection point for operation when remote source is available.
 - 2. DC lighting system for operation when remote source and generator are both unavailable.
- M. Convenience Outlets: Factory wired, GFCI. Arrange for external electrical connection.

2.10 REMOTE RADIATOR MOTORS

- A. Description: NEMA MG 1, Design B, medium induction random-wound, squirrel-cage motor.
- B. Efficiency: Energy efficient, as defined in NEMA MG 1.

- C. Service Factor: 1.15.
- D. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- E. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
- F. Temperature Rise: Match insulation rating.
- G. Code Letter Designation:
 - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
 - 2. Motors Smaller Than 15 HP: Manufacturer's standard starting characteristic.
- H. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.
- I. Controllers, Electrical Devices, and Wiring: Electrical devices and connections are specified in electrical Sections.

2.11 VIBRATION ISOLATION DEVICES

- A. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic restraint.
 - 1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to wind loads or if weight is removed; factory-drilled baseplate bonded to 1/4-inch-thick, elastomeric isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
 - 2. Outside Spring Diameter: Not less than 80 percent of compressed height of the spring at rated load.
 - 3. Minimum Additional Travel: 50 percent of required deflection at rated load.
 - 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - 6. Minimum Deflection: 1 inch.
- B. Comply with requirements in Section 23 21 16 "Hydronic Piping Specialties" for vibration isolation and flexible connector materials for steel piping.
- C. Comply with requirements in Section 23 31 13 "Metal Ducts" for vibration isolation and flexible connector materials for exhaust shroud and ductwork.
- D. Vibration isolation devices shall not be used to accommodate misalignments or to make bends.

2.12 FINISHES

- A. Indoor and Outdoor Enclosures and Components: Manufacturer's standard finish over corrosion-resistant pretreatment and compatible primer.

2.13 SOURCE QUALITY CONTROL

- A. Prototype Testing: Factory test engine generator using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.
 - 1. Tests: Comply with IEEE 115.
- B. Project-Specific Equipment Tests: Before shipment, factory test engine generator and other system components and accessories manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:
 - 1. Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.
 - 2. Test generator, exciter, and voltage regulator as a unit.
 - 3. Full load run.
 - 4. Maximum power.
 - 5. Voltage regulation.
 - 6. Transient and steady-state governing.
 - 7. Single-step load pickup.
 - 8. Safety shutdown.
 - 9. Provide 14 days' advance notice of tests and opportunity for observation of tests by Owner's representative.
 - 10. Report factory test results within 10 days of completion of test.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine generator performance.
- B. Examine roughing-in for piping systems and electrical connections. Verify actual locations of connections before packaged engine generator installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
 - 1. Notify Architect no fewer than two working days in advance of proposed interruption of electrical service.
 - 2. Do not proceed with interruption of electrical service without Architect's written permission.

3.3 INSTALLATION

- A. Comply with NECA 1 and NECA 404.
- B. Comply with packaged engine generator manufacturers' written installation.
- C. Equipment Mounting:
 - 1. Install packaged engine generators on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 03 30 00 "Cast-in-Place Concrete."
 - 2. Coordinate size and location of concrete bases for packaged engine generators and remote radiators mounted on grade. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
 - 3. Install packaged engine generator with restrained spring isolators having a minimum deflection of 1 inch on 4-inch-high concrete base. Secure engine generator enclosure to anchor bolts installed in concrete bases. Concrete base construction is specified in Section 26 05 48.16 "Seismic Controls for Electrical Systems."
 - 4. Remote Radiators:
 - a. Install remote radiator with restrained spring isolators on concrete base on grade.
 - b. Coordinate size and location of roof curbs, equipment supports, and roof penetrations for remote radiators. These items are specified in Section 07 72 00 "Roof Accessories."
- D. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.
- E. Cooling System: Install Schedule 40, black steel piping with welded joints for cooling water piping between engine generator and heat exchanger. Piping materials and installation requirements are specified in Section 23 21 13 "Hydronic Piping."

1. Install isolating thimbles where exhaust piping penetrates combustible surfaces. Provide a minimum of 9 inches clearance from combustibles.
 2. Insulate cooling system piping and components according to requirements in Section 23 07 19 "HVAC Piping Insulation."
- F. Exhaust System: Install Schedule 40, black steel piping with welded joints and connect to engine muffler. Install thimble at wall. Piping shall be same diameter as muffler outlet.
1. Install flexible connectors and steel piping materials according to requirements in Section 23 21 16 "Hydronic Piping Specialties."
 2. Insulate muffler/silencer and exhaust system components according to requirements in Section 23 07 19 "HVAC Piping Insulation."
 3. Install isolating thimbles where exhaust piping penetrates combustible surfaces with a minimum of 9 inches clearance from combustibles.
- G. Drain Piping: Install condensate drain piping to muffler drain outlet with a shutoff valve, stainless-steel flexible connector, and Schedule 40, black steel pipe, the full size of the drain connection, with welded joints.
- H. Gaseous Fuel Piping:
1. Natural gas piping, valves, and specialties for gas distribution are specified in Section 23 11 23 "Facility Natural Gas Piping."
- I. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

3.4 CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping and specialties.
- B. Connect fuel, cooling-system, and exhaust-system piping adjacent to packaged engine generator to allow service and maintenance.
- C. Connect cooling-system water piping to engine generator and heat exchanger with flexible connectors.
- D. Connect engine exhaust pipe to engine with flexible connector.
- E. Gaseous Fuel Connections:
1. Connect fuel piping to engines with a gate valve and union and flexible connector.
 2. Install manual shutoff valve in a remote location to isolate gaseous fuel supply to the generator.

3. Vent gas pressure regulators outside building a minimum of 60 inches from building openings.
- F. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."
- G. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables." Provide a minimum of one 90-degree bend in flexible conduit routed to the engine generator from a stationary element.
- H. Balance single-phase loads to obtain a maximum of 10 percent unbalance between any two phases.

3.5 IDENTIFICATION

- A. Identify system components according to Section 23 05 53 "Identification for HVAC Piping and Equipment" and Section 26 05 53 "Identification for Electrical Systems."
- B. Install a sign indicating the generator neutral is bonded to the main service neutral at the main service location.

3.6 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Tests and Inspections:
 1. Perform tests recommended by manufacturer and each visual and mechanical inspection and electrical and mechanical test listed in the first two subparagraphs below as specified in the NETA ATS. Certify compliance with test parameters.
 - a. Visual and Mechanical Inspection
 - 1) Compare equipment nameplate data with drawings and specifications.
 - 2) Inspect physical and mechanical condition.
 - 3) Inspect anchorage, alignment, and grounding.
 - 4) Verify the unit is clean.
 - b. Electrical and Mechanical Tests
 - 1) Perform insulation-resistance tests in accordance with IEEE 43.
 - a) Machines larger than 200 hp. Test duration shall be 10 minutes. Calculate polarization index.

- b) Machines 200 hp or less. Test duration shall be one minute. Calculate the dielectric-absorption ratio.
 - 2) Test protective relay devices.
 - 3) Verify phase rotation, phasing, and synchronized operation as required by the application.
 - 4) Functionally test engine shutdown for low oil pressure, overtemperature, overspeed, and other protection features as applicable.
 - 5) Perform vibration test for each main bearing cap.
 - 6) Verify correct functioning of the governor and regulator.
 2. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.
 - a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
 - b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
 - c. Verify acceptance of charge for each element of the battery after discharge.
 - d. Verify that measurements are within manufacturer's specifications.
 3. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
 4. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine generator system before and during system operation. Check for air, exhaust, and fluid leaks.
 5. Exhaust-System Back-Pressure Test: Use a manometer with a scale exceeding 40-inch wg. Connect to exhaust line close to engine exhaust manifold. Verify that back pressure at full-rated load is within manufacturer's written allowable limits for the engine.
 6. Exhaust Emissions Test: Comply with applicable government test criteria.
 7. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50 and 100 percent step-load increases and decreases, and verify that performance is as specified.
 8. Harmonic-Content Tests: Measure harmonic content of output voltage at 25 percent and 100 percent of rated linear load. Verify that harmonic content is within specified limits.
 9. Noise Level Tests: Measure A-weighted level of noise emanating from generator-set installation, including engine exhaust and cooling-air intake and discharge, at four locations 25 feet from edge of the generator enclosure on the property line, and compare measured levels with required values.
- C. Coordinate tests with tests for transfer switches and run them concurrently.
- D. Test instruments shall have been calibrated within the last 12 months, traceable to NIST Calibration Services, and adequate for making positive observation of test results. Make calibration records available for examination on request.

- E. Leak Test: After installation, charge exhaust, coolant, and fuel systems and test for leaks. Repair leaks and retest until no leaks exist.
- F. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation for generator and associated equipment.
- G. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- H. Remove and replace malfunctioning units and retest as specified above.
- I. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.
- J. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.
- K. Infrared Scanning: After Substantial Completion, but not more than 60 days after final acceptance, perform an infrared scan of each power wiring termination and each bus connection while running with maximum load. Remove all access panels so terminations and connections are accessible to portable scanner.
 - 1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan 11 months after date of Substantial Completion.
 - 2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - 3. Record of Infrared Scanning: Prepare a certified report that identifies terminations and connections checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.7 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, provide 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include quarterly exercising to check for proper starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Provide parts and supplies same as those used in the manufacture and installation of original equipment.

3.8 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators.

END OF SECTION 26 32 13.17

SECTION 26 36 00 – AUTOMATIC TRANSFER SWITCHES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section includes transfer switches rated 600 V and less, including the following:
 - 1. Automatic transfer switches.
- B. Related Requirements:
 - 1. Section 26 32 13 “Engine Generators”

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, weights, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings: Dimensioned plans, elevations, sections, and details showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.

1.04 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer.
- B. Field quality-control reports.

1.05 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:
 - 1. Features and operating sequences, both automatic and manual.

2. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Maintain a service center capable of providing training, parts, and emergency maintenance repairs within a response period of less than eight hours from time of notification.
- B. Manufacturer to be same as Engine Generator.
- C. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the International Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
 1. Testing Agency's Field Supervisor: Person currently certified by the International Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- D. Source Limitations: Obtain automatic transfer switches through one source from a single manufacturer.
- E. 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.
- F. Comply with NEMA ICS 1.
- G. Comply with NFPA 70.
- H. Comply with NFPA 99.
- I. Comply with NFPA 110.
- J. Comply with UL 1008 unless requirements of these Specifications are stricter.

PART 2 - PRODUCTS

2.01 MANUFACTURED UNITS

- A. Contactor Transfer Switches:
 1. Basis-of-Design Product: Subject to compliance with requirements:
 - a. Cummins.

- b. Kohler
- c. Caterpillar

2. Manufacturer to be same as Engine Generator.

2.02 AUTOMATIC TRANSFER SWITCHES

- A. Comply with Level 1 equipment according to NFPA 110.
- B. Switching Arrangement: Double-throw type, incapable of pauses or intermediate position stops during normal functioning, unless otherwise indicated.
- C. Manual Switch Operation: Under load, with door closed and with either or both sources energized. Transfer time is same as for electrical operation. Control circuit automatically disconnects from electrical operator during manual operation.
- D. Signal-Before-Transfer Contacts: A set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Interval is adjustable from 1 to 30 seconds.
- E. Digital Communication Interface: Matched to capability of remote annunciator or annunciator and control panel.
- F. Automatic Transfer-Switch Features:
 - 1. Under voltage Sensing for Each Phase of Normal Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage is adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
 - 2. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals. Adjustable from zero to six seconds, and factory set for one second.
 - 3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
 - 4. Time Delay for Retransfer to Normal Source: Adjustable from 0 to 30 minutes, and factory set for 10 minutes to automatically defeat delay on loss of voltage or sustained under voltage of emergency source, provided normal supply has been restored.
 - 5. Test Switch: Simulate normal-source failure.
 - 6. Switch-Position Pilot Lights: Indicate source to which load is connected.
 - 7. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.
 - a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."

- b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."
- 8. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V AC.
- 9. Transfer Override Switch: Overrides automatic retransfer control so automatic transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.
- 10. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V DC minimum.
- 11. Engine Shutdown Contacts: Instantaneous; shall initiate shutdown sequence at remote engine-generator controls after retransfer of load to normal source.
- 12. Engine Shutdown Contacts: Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.
- 13. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods are adjustable from 10 to 30 minutes. Factory settings are for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:
 - a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
 - b. Push-button programming control with digital display of settings.
 - c. Integral battery operation of time switch when normal control power is not available.
 - d. Exerciser Transfer Selector Switch to run one time per month on Full-Load.

2.03 SOURCE QUALITY CONTROL

- A. Factory test and inspect components, assembled switches, and associated equipment. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Identify components according to Section 26 05 53 "Identification for Electrical Systems."

- B. Set field-adjustable intervals and delays, relays, and engine exerciser clock.
- C. ATS to be wall mounted per manufacturer's recommendations.

3.02 CONNECTIONS

- A. Wiring to Remote Components: Match type and number of cables and conductors to control and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.
- B. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."
- C. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

3.03 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Testing Agency's Tests and Inspections:
 - 1. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.
 - 2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 3. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.
 - a. Check for electrical continuity of circuits and for short circuits.
 - b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
 - c. Verify that manual transfer warnings are properly placed.
 - d. Perform manual transfer operation.
 - 4. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.
 - a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.

- b. Simulate loss of phase-to-ground voltage for each phase of normal source.
 - c. Verify time-delay settings.
 - d. Verify pickup and dropout voltages by data readout or inspection of control settings.
 - e. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for 1 pole deviating by more than 50 percent from other poles.
 - f. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.
- 5. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.
 - a. Verify grounding connections and locations and ratings of sensors.
- C. Coordinate tests with tests of generator and run them concurrently.
- D. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.
- E. Remove and replace malfunctioning units and retest as specified above.
- F. Prepare test and inspection reports.
- G. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switch. Remove all access panels so joints and connections are accessible to portable scanner.
 - 1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.
 - 2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - 3. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.04 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment as specified below. Refer to Section 01 79 00 "Demonstration and Training."
- B. Coordinate this training with that for generator equipment.

END OF SECTION 26 36 00

SECTION 26 5600 - EXTERIOR LIGHTING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Exterior luminaires.
- B. Poles and accessories.
- C. Luminaire accessories.

1.02 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Materials and installation requirements for concrete bases for poles.
- B. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- C. Section 26 0537 - Boxes.
- D. Section 26 0923 - Lighting Control Devices: Automatic controls for lighting including outdoor motion sensors, time switches, and outdoor photo controls.
- E. Section 26 2726 - Wiring Devices: Receptacles for installation in poles.
- F. Section 26 2813 - Fuses.
- G. Section 26 5100 - Interior Lighting.

1.03 REFERENCE STANDARDS

- A. ANSI C136.10 - American National Standard for Roadway and Area Lighting Equipment - Locking-Type Photocontrol Devices and Mating Receptacles - Physical and Electrical Interchangeability and Testing; 2010.

- B. ANSI O5.1 - American National Standard for Wood Poles -- Specifications and Dimensions; 2015.
- C. IEEE C2 - National Electrical Safety Code; Institute of Electrical and Electronic Engineers; 2012.
- D. IEEE C62.41.2 - Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits; Institute of Electrical and Electronic Engineers; 2002 (Cor 1, 2012).
- E. IESNA LM-5 - Photometric Measurements of Area and Sports Lighting Installations; Illuminating Engineering Society; 2004 (Reaffirmed 2007).
- F. IESNA LM-63 - ANSI Approved Standard File Format for Electronic Transfer of Photometric Data and Related Information; Illuminating Engineering Society; 2002 (Reaffirmed 2008).
- G. IES LM-79 – Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products; Illuminating Engineering Society; 2008.
- H. IES LM-80 - Approved Method: Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays, and Modules; Illuminating Engineering Society; 2015.
- I. IES RP-8 - Roadway Lighting; Illuminating Engineering Society; 2014 (ANSI/IES RP-8).
- J. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2010.
- K. NECA/IESNA 501 - Recommended Practice for Installing Exterior Lighting Systems; National Electrical Contractors Association; 2006.
- L. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Fluorescent Ballasts; National Electrical Manufacturers Association; 2011.
- M. NEMA LE 4 - Recessed Luminaires, Ceiling Compatibility; National Electrical Manufacturers Association; 2012.

- N. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- O. UL 1598 - Luminaires; Current Edition, Including All Revisions.
- P. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate placement of poles and associated foundations with utilities, curbs, sidewalks, trees, walls, fences, striping, etc. installed under other sections or by others. Coordinate elevation to obtain specified foundation height.
 - 2. Notify Architect of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements and Section 26 0200 - Basic Electrical Requirements, for submittal procedures.
- B. Prior Approval: If luminaires other than the named product are submitted in consideration for inclusion within the project, all of the following requirements must be met. Failure to meet any one of the following requirements will constitute failure to comply with the project requirements and the submitted package will not be considered for inclusion.
 - 1. Specifications Compliance: Submit a line-by-line comparison that describes the differences between each specifications requirement and the equipment / systems being proposed. Comparison shall include a complete listing of how the proposed equipment / systems differ from that specified with regard to size, quantity, quality, method of control, features and functions, control software functions and installation requirements.
 - 2. System Description: Where luminaires are specified with integral controls, supply as part of the submittal package a brief description of the lighting control system's major features and functions.
 - 3. Bill of Materials: Provide as part of the submittal package a detailed itemized listing, using the Engineer's project naming convention, of all proposed equipment, including quantities and capacities for all major system components.

4. Product Data Sheets: Provide as part of the submittal package, detailed product data sheets, using the engineer's project naming convention, providing one individual product data sheet per each specified component, for all major system components.
 5. Warranty: Provide as part of the submittal package a complete written warranty.
 6. Photometric Calculations: Due to the difference in performance in fixtures between manufacturers, if luminaires other than the Basis of Design luminaires as indicated within the Luminaire Schedule are submitted for approval, provide in *.pdf format, a site plan with the Architect's and Civil Engineer's current backgrounds, using the same scale and text height as the engineering site plans, with point-by-point, direct radiosity illuminance calculations in a 10'x10' calculation point grid to two decimal places, electronic copy of all *.ies files with an individual *.ies file for each luminaire using the engineer's project naming convention, complete exterior space-by-space calculation summary table for all calculation areas with each area name clearly indicated using Engineer's naming project convention, calculation plane height, light loss factor, initial lumens, and mounting height clearly indicated for all luminaires for evaluation of accuracy and conformance to the design intent by the Engineer.
 - a. Provide Photometric Calculations for the following spaces: provide outdoor lighting photometrics for the entire project site.
- C. Samples: Engineer may request the vendor provide sample(s) of lighting fixture(s) to review.
- D. Shop Drawings:
1. Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
 2. Provide structural calculations for each pole proposed for substitution.
- E. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, weight, effective projected area (EPA), and installed accessories; include model number nomenclature clearly marked with all proposed features.
1. Provide submittals for this Section concurrently with Sections 26 0923, 26 0918 and 26 5600.
 2. Arrange in order of luminaire designation.
 3. LED Luminaires:
 - a. Include estimated useful life, calculated based on IES LM-80 test data.
 - b. Include IES LM-79 test report upon request.
 4. Poles: Include information on maximum supported effective projected area (EPA) and weight for the design wind speed.

- F. Delegated Design: The selected Contractor shall provide and submit to the engineer, a project specific, pole base installation detail which has been prepared and sealed by a structural engineer. The detail shall specify exact pole base dimensions, materials, ect. for all luminaires and poles provided for this project. All luminaire poles and pole bases shall be provided as required for proper structural and wind loading support within the project site wind region and soil conditions.
- F. Operation and Maintenance Data: Instructions for each product including information on replacement parts.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
 - 2. Extra Fuses: Five percent of total quantity installed for each type, but not less than two of each type.
 - 3. Touch-Up Paint: 2 gallons, to match color of pole finish.
- H. Project Record Documents: Record actual connections and locations of pole foundations, luminaires, and any pull or junction boxes.

1.06 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, handle, and store products according to NECA/IESNA 501 and manufacturer's written instructions.
- B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.
- C. Receive, handle, and store wood poles in accordance with ANSI O5.1.

1.08 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year manufacturer warranty for all LED luminaires, including drivers.

PART 2 PRODUCTS

2.01 LUMINAIRE TYPES

- A. Basis-of-Design Product: The design for each lighting fixture is based on the product as indicated in Exterior Luminaire Schedule included on the drawings. Subject to compliance with requirements, provide either the named product or a comparable product as approved by the Engineer. Reference Prior Approval requirements under SUBMITTALS for luminaires other than the named basis-of-design product. All substitution requests shall be submitted 11 business days prior to bid.

2.02 LUMINAIRES

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products that are listed and labeled as complying with UL 1598, where applicable.
- C. Provide products listed, classified, and labeled as suitable for the purpose intended.
- D. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.
- E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, poles, foundations, supports, trims, accessories, etc. as necessary for a complete operating system.
- F. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.
- G. Provide luminaires listed and labeled as suitable for wet locations unless otherwise indicated.

H. Recessed Luminaires:

1. Ceiling Compatibility: Comply with NEMA LE 4.
2. Luminaires Recessed in Insulated Ceilings: Listed and labeled as IC-rated, suitable for direct contact with insulation and combustible materials.
3. Luminaires Recessed in Sloped Ceilings: Provide suitable sloped ceiling adapters.

I. LED Luminaires:

1. Components: UL 8750 recognized or listed as applicable.
2. Tested in accordance with IES LM-79 and IES LM-80.
3. LED Estimated Useful Life: Minimum of 50,000 hours at 70 percent lumen maintenance, calculated based on IES LM-80 test data.
4. In Exterior Luminaire Schedule, where lumens is indicated, the product shall be within 10% of the value indicated for the basis-of-design fixture.
5. In Exterior Luminaire Schedule, where CCT is indicated, the product shall be within 100 K of the value indicated for the basis-of-design fixture.
6. In Exterior Luminaire Schedule, where CRI is indicated, the product shall be not less than the value indicated for the basis-of-design fixture.
7. In Exterior Luminaire Schedule, where Input VA is indicated, the product shall be not more than the value indicated for the basis-of-design fixture.

J. Exposed Hardware: Stainless steel.

2.03 POLES

A. All Poles:

1. Provide poles and associated support components suitable for the luminaire(s) and associated supports and accessories to be installed.
2. Material: Steel, unless otherwise indicated.
3. Shape: Round straight, unless otherwise indicated.
4. Finish: Match luminaire finish, unless otherwise indicated.
5. Mounting Height: as indicated on the plans, unless the local authority having jurisdiction has a mounting height restriction that is lower than the height indicated on the plans, then the lower height shall take precedence.
6. Mounting: Install on concrete foundation, height as indicated on the drawings, unless otherwise indicated.
7. Unless otherwise indicated, provide with the following features/accessories:
 - a. Top cap.
 - b. Handhole.
 - c. Anchor bolts with leveling nuts.
 - d. Anchor base cover.

- e. Provision for pole-mounted weatherproof GFI receptacle where indicated.
- f. Brackets.

B. Metal Poles: Provide ground lug, accessible from handhole or transformer base.

2.04 FINISHES

- A. Variations in Finishes: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- B. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and factory-tested luminaire before shipping. Match finish process and color of pole or support materials where indicated.
- C. Factory-Applied Finish for Steel Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - 1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
 - 2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.
 - a. Color: As selected from manufacturer's standard catalog of colors.

2.05 ACCESSORIES

- A. Stems for Suspended Luminaires: Steel tubing, minimum 1/2" size, factory finished to match luminaire or field-painted as directed.
- B. Threaded Rods for Suspended Luminaires: Zinc-plated steel, minimum 1/4" size, field-painted as directed.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as shown on the drawings.

- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.
- C. Verify that suitable support frames are installed where required.
- D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 TEMPORARY LIGHTING

- A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is substantially complete, clean and repair luminaires used for temporary lighting.

3.03 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.04 INSTALLATION

- A. Coordinate locations of outlet boxes provided under Section 26 0537 as required for installation of luminaires provided under this section.
- B. Install products according to manufacturer's instructions.
- C. Install luminaires securely, in a neat and workmanlike manner, as specified in NECA 1 (general workmanship) and NECA/IESNA 501 (exterior lighting).
- D. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.
- E. Recessed Luminaires:
 - 1. Install trims tight to mounting surface with no visible light leakage.

2. Non-IC Rated Luminaires: Maintain required separation from insulation and combustible materials according to listing.
3. Luminaires Recessed in Fire-Rated Ceilings: Install using accessories and firestopping materials to meet regulatory requirements for fire rating.

F. Suspended Luminaires:

1. Unless otherwise indicated, specified mounting heights are to bottom of luminaire.
2. Install using the suspension method indicated, with support lengths and accessories as required for specified mounting height.
3. Provide minimum of two supports for each luminaire equal to or exceeding 4 feet in length, with no more than 4 feet between supports.
4. Install canopies tight to mounting surface.
5. Unless otherwise indicated, support pendants from swivel hangers.

G. Wall-Mounted Luminaires: Unless otherwise indicated, specified mounting heights are to center of luminaire.

H. Pole-Mounted Luminaires:

1. Maintain the following minimum clearances:
 - a. Comply with IEEE C2.
 - b. Comply with utility company requirements.
2. Foundation-Mounted Poles:
 - a. Provide cast-in-place concrete foundations for poles as indicated, in accordance with Section 03 3000.
 - 1) Install anchor bolts plumb per template furnished by pole manufacturer.
 - 2) Position conduits to enter pole shaft.
 - b. Install foundations plumb.
 - c. Install poles plumb, using leveling nuts as required to adjust to plumb.
 - d. Tighten anchor bolt nuts to manufacturer's recommended torque.
 - e. Install non-shrink grout between pole anchor base and concrete foundation, leaving small channel for condensation drainage.
 - f. Install anchor base covers or anchor bolt covers as indicated.
3. Grounding:
 - a. Bond luminaires, metal accessories, metal poles, and foundation reinforcement to branch circuit equipment grounding conductor.
 - b. Provide supplementary ground rod electrode as specified in Section 26 0526 at each pole bonded to grounding system as indicated.
4. Install separate service conductors, size as indicated on drawings, from each luminaire down to handhole for connection to branch circuit conductors.
5. Install weather resistant GFI duplex receptacle with weatherproof cover as specified in Section 26 2726 in designated poles.

- I. Install accessories furnished with each luminaire.
- J. Bond products and metal accessories to branch circuit equipment grounding conductor.
- K. Install lamps in each luminaire.

3.05 CORROSION PREVENTION

- A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.
- B. Steel Conduits: In concrete foundations, wrap conduit with 0.010-inch- thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.06 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 0553 - Identification for Electrical Systems.

3.07 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Inspect each product for damage and defects.
- C. Operate each luminaire after installation and connection to verify proper operation.
- D. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Architect.

3.08 ADJUSTING

- A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Architect. Secure locking fittings in place.
- B. Luminaires with Field-Rotatable Optics: Position optics according to manufacturer's instructions to achieve lighting distribution as indicated or as directed by Architect.

3.09 CLEANING

- A. Clean surfaces according to NECA/IESNA 501 and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

3.10 CLOSEOUT ACTIVITIES

- A. See Section 01 7800 - Closeout Submittals, for closeout submittals.
- B. See Section 01 7900 - Demonstration and Training, for additional requirements.
- C. Demonstration: Demonstrate proper operation of luminaires to Architect, and correct deficiencies or make adjustments as directed.
- D. Just prior to Substantial Completion, replace all lamps that have failed.

3.11 PROTECTION

- A. Protect installed luminaires from subsequent construction operations.

END OF SECTION 26 56 00

SECTION 31 10 00 - SITE CLEARING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes: Provide all operations required in connection with the general clearing of the site, including the following:
 - 1. Stripping of top soil
 - 2. Clearing and grubbing of site areas at all new paving
 - 3. Preservation of existing utilities
 - 4. Demolition of existing above and below grade improvements as required by the Work of the Contract
 - 5. Removal of all existing and generated trash and during clearing and grubbing
 - 6. Location and protection of bench marks
- B. Related Sections include the following:
 - 1. Division 2 Section "Earthwork."

1.03 COORDINATION

- A. Coordinate clearing work with the work of other related trades so as not to delay progress of any section of the work.
- B. Notify and coordinate with any and all utility companies or agencies as required for capping, removal, by-passing or protections of existing utility lines.

1.04 GENERAL REQUIREMENTS

- A. Comply with all applicable federal, state and local codes and ordinances and with the requirements of insurance carriers providing coverage for this work.
- B. Procure and pay for all permits or certificates required for the work involved.

1.05 EXAMINATION OF SITE

- A. Contractor shall visit and examine the site to ascertain the actual nature and scope of any demolition work. Later claims for additional compensation covering difficulties encountered in demolition work will not be recognized.

PART 2 - PRODUCTS

2.01 STOCK PILING

- A. Store topsoil, stripped from site improvement areas, in areas designated or approved by Architect for distribution or removal later. Handle topsoil carefully to prevent contamination with undesirable materials. Topsoil so stored shall be reasonably free from debris.
- B. Salvageable materials, if any, resulting from clearing work shall become the property of the Contractor, unless identified to be retained by the Owner.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Consult Owner prior to removal of existing trees and shrubs. Tag all plant material identified to remain.

3.02 PROTECTION

- A. Before and during site clearing operations, Contractor shall ascertain where existing utilities are located. Any damage that may occur to existing services shall be promptly corrected by the Contractor at no additional cost to the Owner.
- B. Prior to beginning stripping and clearing, coordinate with Architect on methods and markings of areas not to be disturbed.
- C. Erect necessary barricades, and protective measures as required.
- D. Protect trees, plant growth, and features designated to remain as final landscaping. Barricades shall be placed around the drip line of trees indicated to remain that are within the construction area. Vehicle traffic shall not be allowed under any trees.

3.03 STRIPPING OF TOPSOIL

- A. Scrape and remove all brush, weeds, grass, roots and other material from areas which are to be stripped of topsoil.
- B. Strip to a depth of 6" from the areas within lines 5'-0" outside of foundation walls of buildings and from under all walk and paving areas.
- C. Pile topsoil in designated locations, where it will not interfere with construction or utility operations, for use in planting areas. Remove excess and/or unacceptable top soil from the site.

3.04 CLEARING

- A. Clear the area within the limits to remove all subterranean or surface material, growth or other obstructions.
- B. Remove all stones, stumps, roots, old concrete masses or other similar items larger than 3/4" diameter, to a minimum depth of 24" below natural grade in landscape bed areas and 6" below proposed grades in areas to be covered by building or paving.
- C. Remove trees and stumps from area of improvements as shown on drawings. Do not remove other trees without approval from the Owner. Use methods of removal which will prevent damage to remaining plant materials and property.
- D. Fill any holes left by removal of large stones or stumps per requirements of applicable articles of Division 31 Section – "Earthwork". Compact backfill to the density of surrounding soils.
- E. Following each day of grubbing activity, grade surface to remove open holes and ruts and allow unrestrained runoff of storm water. Ponding will not be permitted.

3.05 DEMOLITION

- A. Remove all obstructions located within or outside the property lines that would interfere with installation of new work such as paving, walks, curbs, slabs, walls and other items. No high impact vibrations permitted. Execute all clearing work by methods which will prevent damage to other work or adjoining properties and which will prevent settlement or erosion to adjoining areas.
- B. Unless otherwise noted to remain, clear the site of all existing pavements, concrete walks, concrete steps, fences, structures and the like to a depth of 24" below proposed grades.
- C. Refer to Topographic Survey Drawing for location of existing items and structures which are affected by demolition and clearing/grubbing requirements.

3.06 DISPOSAL

- A. Except as otherwise provided, all items cleared from the site, including all asphalt, concrete, building materials, rubbish, brush, stumps, debris, etc., resulting from the work of this section shall be removed and disposed of off-site.

END OF SECTION 31 10 00

SECTION 31 22 00 - EARTHWORK

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Earthwork materials
 - 2. Excavating and backfill
 - 3. Preparing subgrade
 - 4. Soil stabilization
 - 5. Testing requirements
- B. Related Sections include the following:
 - 1. Division 01 Section "Soil Report."
 - 2. Division 01 Section "Testing."
 - 3. Division 07 Section "Vapor Barrier".
 - 4. Division 31 Section "Clearing."
 - 5. Division 31 Section "Soil Stabilization."
 - 6. Division 32 Section "Asphalt Concrete Paving."
 - 7. Division 32 Section "Concrete Paving."
 - 8. Division 33 Section "Utilities."

1.03 SCOPE

- A. Provide required earthwork relating to building structures and site improvements including excavation, fill, backfill and grading as shown on drawings and as herein specified.

1.04 SOIL REPORT

- A. A copy of the soil report and test boring results is **[bound herein][available from the Owner]**. This report is for information only and is not guaranteed for accuracy of existing conditions by Owner or Architect. Should this section conflict with requirements stated in the soils report, the soils report shall be governing. Notify the Structural Engineer as to those conflicts.

1.05 SAMPLES

- A. Division 1 Section - Submittal Procedures: Procedures for submittals.
- B. Submit samples of materials requiring laboratory testing in sufficient quantity necessary to adequately investigate soil.

1.06 JOB CONDITIONS

- A. Maintain all existing and newly established bench marks. Report discrepancies found to the Architect, who reserves the right to make minor adjustments necessary to accomplish the intent of the Contract Documents, at no additional cost to the Owner. Contractor solely responsible for all elevations, dimensions, and verifications of conditions.

1.07 PROTECTION

- A. Provide for surface drainage during the period of construction in a manner to avoid creating a nuisance to adjacent areas and to prevent water runoff into excavation. Provide pumping as required to keep excavated areas free of water during construction. Ponding of water during construction shall be prevented at all times.
- B. Provide adequate sheeting, shoring and bracing for excavations to prevent caving and to protect personnel.
- C. Protect all building walls, curbs, and slabs against discoloration or damage from work under this Section.
- D. Protection of existing landscape features indicated to remain as a portion of final landscaping.
- E. Protect above and below grade utilities to remain.

1.08 OBSTRUCTIONS

- A. Should utilities be encountered which interfere with the work, it is the Contractor's responsibility to notify the Owner and Architect. The Owner shall direct the Contractor to remove, relocate or cap off same.

PART 2 - PRODUCTS

2.01 STOCK PILING

- A. Fill material required to be hauled in may be stockpiled at site until used, provided it is properly handled to prevent contamination with undesirable materials. Stock pile topsoil separate from excavated subsoil.

2.02 SURPLUS MATERIALS

- A. Remove excavated materials not suitable for use in fills and backfills on this project from site. Materials containing rubbish, debris or rocks shall be removed.

2.03 MATERIALS

- A. Fill: (at pavement) on site, inorganic soil free from vegetable matter, debris, and other deleterious matter capable of being compacted to 95% maximum density at optimum moisture content; ASTM D-698, or select fill.
- B. Select Fill: (within building lines and beneath paving areas) Homogenous and non-expansive, having a plasticity index between 4 and 12, and a liquid limit less than 50. Select fill shall contain no rock greater than 4" in maximum dimension. Submit lab analysis for approval, complete with lab analysis of fill.
- C. Topsoil: Clean, natural topsoil free of vegetation, debris, and other deleterious matter. Upper 6" of topsoil stripped from site may be used.
- D. Sand Cushion Under Slabs on Grade: Pit run sand graded in accord with ASTM C136, free of organic matter, clays or other binder materials. Submit samples for approval.
- E. Vapor Barrier: Division 07 Section.
- F. Lime: Hydrated lime conforming to applicable sections of ASTM C-207, Type N. Lime quantity tickets supplied to Owner's testing lab upon delivery of each load.
- G. Filter Fabric: Prefabricated drainage composite geotextile shall be Mirafi 140 Fabric at under-building drainage, or approved equal by JDR or Monsanto.

PART 3 - EXECUTION

3.01 EXCAVATION

- A. Strip objectionable materials from areas to be graded before grading operation begins. Excavate subsoil required for building foundation construction operations and other work. Excavations and rough grading shall be made to lines and grades shown and "feathered" into adjoining grades to insure a smooth transition. Maintain excavations so they drain and are kept free of excess water. Provide pumping as required. Fill over-excavated areas under structure-bearing surfaces in accord with directions of Owner.
- B. Any materials resulting from operations that are unsuitable for use or disposal at the site shall become the property of the Contractor and be removed from the site.
- C. Trenching for underground piping, electrical conduits, etc., shall be done by the trade installing the pipes, conduits, etc. Backfilling of trenches shall conform to the requirements for compacted select fill.
- D. Abandoned Utility Lines and Sewers: Plug in accordance with utility company and/or local requirements any abandoned lines or pipes encountered during excavation using concrete plugs at least 6" thick and at a minimum distance of 3' outside improved areas.
- E. Finish excavations within a tolerance of .05 foot above or 0.1 foot below required grades.

3.02 SUBGRADE PREPARATION AND FILLING

- A. Lay out work to insure that all finish grades of all paving have the proper slope to insure proper drainage.
- B. Establish new grades as necessary and verify all measurements and grades. Set all stakes, etc., to insure an engineering degree of accuracy.
- C. Establish all grades and curbs of adjacent streets.
- D. Scarify exposed subgrade to a depth of 6" and re-compact to a minimum of 98% of standard proctor density (ASTM D-698) at its optimum moisture content to 4% above its optimum moisture content.
- E. Provide select fill material. Select fill material shall be placed in loose lifts of 6" to 8" thick and uniformly compacted to a minimum of 95% of standard proctor density (ASTM D-698) at minus 1% to plus 3% of its optimum moisture content.
- F. Additional fill may be clean, on-site clays free of debris, vegetation, and organic material. Clay fill shall be placed in 8" maximum loose lifts at +5% to -3% of optimum moisture and compacted to 95% of the standard proctor dry density (ASTM D-698). Moisture content shall be maintained until pavement or additional fill is placed.
- G. The cross-section of the finished subgrade shall be free from ridges or valleys and be within 0.05 of a foot above or below the theoretical section at any point on the cross-section.
- H. Finished subgrade that does not conform to the above requirement shall be bladed and thoroughly re-compact to conform to the requirements.
- I. Clean surface or subgrade of all loose materials by brooming or other approved methods.

3.03 SOIL STABILIZATION

- A. Subgrade of all paving shall be lime stabilized.
- B. Insure that surfaces have been brought to approximate rough grades.
- C. Loosen and pulverize soil to a compacted depth of 6" beneath designated paving areas including a distance of 2 feet outside perimeter of paving.
- D. Mix soil and lime thoroughly by approved road mixer or other equipment until a homogeneous, friable mixture of soil and lime is obtained; free from all clods or lumps.

- E. Begin compaction of the mixture immediately after final mixing. Aerate or sprinkler material as necessary to provide optimum moisture. Begin compaction at the bottom and continue until entire depth of the mixture is uniformly compacted.
- F. A minimum of 7% hydrated lime (THD Item 264) (COG Item 4.6) should be used. Lime should be thoroughly mixed and blended with the top 6" of the subgrade (THD Item 260) and the mixture compacted to a minimum of 95% of ASTM D-698 at its optimum moisture content to 4% above its optimum moisture content.
- G. Rework as necessary to obtain the specified density if any portion fails to meet the density specified.
- H. Shape surface after mixture has been compacted to the required lines, grades and cross-sections and thoroughly roll with pneumatic or other suitable rollers sufficient light to prevent hair cracking.
- I. Prepare only sufficient amount of subgrade in advance of placing paving, walks, curbs, etc., to enable the work to proceed smoothly and effectively.

3.04 BACKFILLING

- A. Do not backfill against grade beams until after form work has been removed and concrete has set up. Backfill against grade beams so as to provide positive drainage away from the structure.
- B. Finished subgrade surfaces generally not more than 0.5 inches above or below established grades. Tolerance for areas within 10 feet of building and all areas to be paved not more than .25 inches above or below established grades. Provide roundings at top and bottom of banks and at other breaks in grade. Unless otherwise noted, subgrade evenly sloped to provide drainage away from building walls, slope 1/4 inch per foot.
- C. Compact backfill to 95% of maximum density at 2% below and 3% above optimum moisture content as determined by standard proctor test (ASTM D-698).
- D. Backfill over filter fabric in tot lots with washed river gravel of 1/4 to 3/4" size and overlay with additional layer of filter fabric prior to installation of wood mulch.

3.05 VAPOR BARRIER

- A. Place under all floor slabs on grade. Lap all joints 6" minimum and seal with compound recommended by manufacturer; seal around all openings through vapor barrier.

3.06 GRADING

- A. After site has been cleared of construction debris, grade the site to the contours and spot elevation.
- B. Ponding of water on the site will not be permitted. Finished grades shall not be more than 0.10 foot above or below established grade elevations.

3.07 PROTECTION, CLEAN-UP AND EXCESS MATERIAL

- A. Protect grades from construction and weather damage, washing, erosion and rutting, and repair such damage that occurs.
- B. Correct any settlement below established grades to prevent ponding of water.
- C. Remove excess stock pile materials, debris, waste and other materials from site and leave work in clean, finished condition for final acceptance. Contractor is responsible for disposal of debris and excess materials.

3.08 FIELD QUALITY CONTROL

- A. The Owner will employ and pay for services of an independent testing laboratory to perform inspection and testing services specified in this section.
- B. Excavation: Observe the excavation process on a periodic basis, noting the exposed faces of the excavation. Immediately report any observed unsafe conditions.
- C. Filling and Backfilling:
 - 1. The Contractor shall make available to the laboratory, adequate samples of each fill and backfill material from the proposed sources of supply not less than 10 days prior to the start of the work.
 - 2. The Laboratory shall analyze the samples as required to provide a soil description and to determine compliance with the quality requirements.
 - a. Test for liquid limit in accordance with ASTM D423.
 - b. Test for plastic limit of soils and plasticity index of soils in accordance with ASTM D424.
 - c. Test for moisture density relations of soil in accordance with ASTM D698.
 - 3. Furnish a report for each individual test and state whether sample conforms to the specified requirements or reasons for nonconformance.
 - 4. Inspect and approve subgrade prior to placement of fill material.
 - 5. Make in-place compaction tests for moisture content, moisture-density relationship, and density of fill materials.
 - 6. Perform not less than two compaction tests for each 3,000 SF of surface for each layer of fill under the building and not less than two compaction tests for each 5,000 SF of surface for each layer of fill or undisturbed earth on areas of site to be covered by paving walks or traffic approaches.
- D. Footing Excavations: Inspect footing excavations to determine that the proper bearing stratum is obtained and that excavations are properly clean and dry before concrete is placed.

END OF SECTION 31 22 00

SECTION 31 23 00 - EXCAVATION AND FILL

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Excavating and backfilling for structures, utilities, and pavement.
 - 2. Pipe bedding.
 - 3. Compacting fill materials.
 - 4. Borings and casings under roads.
- B. Related Documents: The Contract Documents, as defined in Division 1 Section - Summary of Work, apply to the Work of this Section. Additional requirements and information necessary to complete the Work of this Section may be found in other Documents.

1.02 DEFINITIONS

- A. Building Area Subgrade Pad: Portion of site directly beneath and within a line 10 feet beyond building and appurtenances including limits of any future building expansion areas indicated on Drawings.

1.03 SUBMITTALS

- A. Division 1 Section - Submittal Procedures: Procedures for submittals.
 - 1. Assurance/Control Submittals:
 - a. Material Source: Submit name of imported materials suppliers. Provide materials from same source throughout the work. Change of source requires Architect approval.
 - b. Test Reports: Submit the following reports directly to Architect from Testing Laboratory, with copy to Contractor:
 - 1) Test reports on borrow material.
 - 2) Verification of each footing subgrade.
 - 3) Field density test reports.
 - 4) Optimum moisture-maximum density curve for each type of soil encountered.
 - 5) Report of actual unconfined compressive strength and bearing tests/results for each strata tested. Give "three-dimensional" description of each test location.
- B. Division 1 Section - Closeout Submittals: Procedures for closeout submittals.
 - 1. Project Record Documents: Accurately record the following.
 - a. Spot elevations for building area subgrade pad.
 - b. Location of existing utilities remaining, re-routed utilities, new utilities by horizontal dimensions, elevations or inverts, and slope gradients.

1.04 PROJECT CONDITIONS OR SITE CONDITIONS

- A. Existing Conditions: Requirements specified in Division 2 Section.
- B. Existing Utilities: Requirements specified in Division 2 Section.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Stockpiled on-site fill and backfill material specified in Division 31 Section, tested by Testing Laboratory and approved by Architect.

- B. Imported off-site fill and backfill material specified in Division 31 Section, tested by Testing Laboratory and approved by Architect.
- C. Pipe Bedding Material: Processed sand and gravel free from clay lumps, organic, or other deleterious material complying with the following gradation requirements:

a. SIEVE SIZE	PERCENT PASSING
b. 1 Inch	100
c. 3/4 Inch	90 to 100
d. 3/8 Inch	20 to 55
e. No. 4	0 to 10
f. No. 8	0 to 5
- D. Steel Casing Pipe: AWWA C 200, minimum grade B; size and wall thickness as indicated on Drawings.
- E. Stabilization Fabrics and Geogrids:
 - 1. Mirafi 500X or 600X.
 - 2. Amoco Style #2002 Woven.
 - 3. Reemay Typar 3401 and 3601.
 - 4. Trevira S1114 and S1120.
 - 5. Tensar 1100 and 1200.
- F. Filter/Drainage Fabrics:
 - 1. Mirafi 140 N.
 - 2. Amoco Style #4546.
 - 3. Reemay Typar 3341.
 - 4. Carthage Mills, Carthage 6%.

PART 3 - EXECUTION

3.01 EXCAVATION

- A. Excavation for filling and grading specified in Division 31 Section.
- B. Rock excavation specified in Division 31 Section.
- C. Excavation for Structures:
 - 1. Excavate subbase for building foundations, slabs-on-grade and site structures to width and depth indicated on Drawings.
 - a. Cut excavation banks vertically.
 - b. Remove rocks, loose soil, and debris from bottom of excavation.
 - c. Overexcavate wet or unsuitable soil from bottom of excavation.
 - d. Provide stable base for concrete reinforcing installation and concrete placement.
 - e. Hand trim to indicated lines and grades just prior to concrete reinforcing installation.
 - 2. Provide protection for workers within trench areas in accordance with local, state, and national Occupational Safety and Health requirements and regulations.
 - a. Trenches minimum 4 feet in depth.
 - 3. During excavation, stockpile materials suitable for backfilling away from excavation to prevent overloading, slides, or cave-ins.
 - 4. Remove material encountered in excavating operations that is unsuitable for backfilling, subgrade or foundation purposes as determined by Testing Laboratory and Architect. Dispose of materials off-site in an approved manner in accordance with requirements of authorities having jurisdiction.
 - 5. Prevent surface water from flowing into excavations by temporary grading or other approved methods.
 - a. Do not allow water to accumulate in excavations.
 - b. Remove accumulated water in excavations.

- c. Provide and maintain pumps, well points, sumps, suction and discharge lines, and other dewatering system components required to remove water from excavations.
- D. Excavation for Utilities:
1. Excavate trench width and depth required for laying pipe, conduit, or cable. Cut trench banks vertical. Remove stones from bottom of trench as required to avoid point-bearing. Over excavate wet or unstable soil, if encountered, from trench bottom as required to provide suitable base for continuous and uniform bedding.
 2. During excavation, stockpile materials suitable for backfilling away from trench bank to prevent overloading, slides, or cave-ins.
 3. Remove material encountered in trenching operations that is unsuitable for backfilling, subgrade or foundation purposes as determined by Testing Laboratory and Architect. Dispose of materials off-site in an approved manner in accordance with requirements of authorities having jurisdiction.
 4. Prevent surface water from flowing into trenches or other excavations by temporary grading or other approved methods.
 - a. Do not allow water to accumulate in excavations.
 - b. Remove accumulated water in excavations.
 - c. Provide and maintain pumps, well points, sumps, suction and discharge lines and other dewatering system components required to remove water from excavations.
 5. Open cut excavation using trenching machine or backhoe. Do not use dirt clods for backfill created by use of machines other than ladder or wheel-type trenching machines.
 6. Grade trench bottom to provide uniform bearing and support for each section of pipe on bedding material along entire trench length, except where necessary to excavate for bell holes, proper sealing of pipe joints, or other required connections. Dig bell holes and depressions for joints after trench bottom has been graded. Do not excavate trench deeper, longer, or wider than required to make proper joint connection.
 7. Excavate trench width below the top of pipe minimum 300 mm wide and maximum 460 mm wider than outside surface of pipe or conduit installed to elevations and grades indicated on Drawings. Excavate trench width for other pipe, conduit, or cable to least practical width allowing for proper compaction of trench backfill.
 8. Excavate trench depth measured from finished grade or paved surface to the following requirements or applicable codes and ordinances:
 - a. Water Mains: 30 inches to top of pipe barrel or 6 inches below frost line established by local building official, whichever is deeper.
 - b. Sanitary Sewer: Elevations, and grades indicated on Drawings.
 - c. Storm Sewer: Depths, elevations, and grades indicated on Drawings.
 - d. Electrical Conduits: 24 inches minimum to top of conduit or as required by NFPA 70, or local utility company requirements, whichever is deeper.
 - e. TV Conduits: 18 inches minimum to top of conduit or as required by local utility company, whichever is deeper.
 - f. Telephone Conduits: 18 inches minimum to top of conduit, or as required by local utility company, whichever is deeper.
 - g. Gas Mains and Service: 30 inches minimum to top of pipe, or as required by local utility company, whichever is deeper.
 9. Provide shoring, sheeting, and bracing, as required, in trenches and other excavations where protection of construction personnel is required. Sheeting may be removed after sufficient backfilling to protect against damaging or injurious caving.
- E. Excavation for Pavement:
1. Excavate roadway and pavement areas to line and grade indicated on Drawings.
 2. Stockpile excavated material suitable for backfilling on-site.
 3. Remove excavated materials not required or not suitable for backfill from site.

4. Overexcavate areas of pavement subgrade found to contain unsuitable material. Prepare, fill with suitable material, and compact as specified. Stabilize areas as specified in Division 31 Section.

3.02 PIPE BEDDING

- A. Excavate trenches, for pipe or conduit installed to elevations indicated on Drawings, 4 inches below bottom of pipe and to width as specified. Place 4 inches of bedding material, compact in bottom of trench, and shape to conform to lower portion of pipe barrel. After pipe installation, backfill and compact to top of trench.
- B. Place geotextile fabric as indicated on Drawings.

3.03 BACKFILLING AND SUBGRADE PREPARATION

- A. Backfilling:
 1. Verify that imported off-site fill and stockpiled on-site fill is tested and approved.
 2. Verify that foundation perimeter drainage installation is inspected and approved.
 3. Verify that foundation or below grade structure walls are braced to support surcharge forces imposed by backfilling operations.
 4. Verify that backfill areas are free of debris, snow, ice, or water, and that ground surfaces are not frozen.
- B. Prepare building area subgrade pad in accordance with foundation subsurface preparation information indicated on Drawings and specified herein. Do not use rock larger than 6 inches for building subgrade fill.
- C. Areas Exposed by Excavation or Stripping:
 1. Scarify areas exposed by excavation or stripping on which building subgrade preparations are to be performed to minimum [8] [____] inch depth.
 2. Compact to minimum [95] [____] percent optimum density in accordance with ASTM D1557 (Modified Proctor) at minimum moisture content [1] [____] percent below and maximum [3] [____] percent above optimum moisture content.
 3. Proofroll to detect any areas of insufficient compaction by making minimum of 2 complete passes with fully-loaded tandem-axle dump truck, or Architect approved equivalent, in each of two perpendicular directions under supervision and direction of Architect.
 4. Excavate and recompact areas failing to meet specified requirements.
- D. Fill Material Placement:
 1. Place in [8] [____] inch maximum lifts compacted minimum [95] [____] percent optimum density in accordance with ASTM D1557 (Modified Proctor) at minimum moisture content of [1] [____] percent below and maximum moisture content [3] [____] percent above optimum moisture content.
 2. Maximum allowable values for plasticity index (PI) and liquid limit (LL) of suitable fill materials to be used as fill in the specified areas, unless indicated otherwise on Drawings:

a. LOCATION	PI	LL
b. Building area, below upper 4 feet	[30] [____]	[40] [____]
c. of proposed subgrade elevation		
d. Building area, upper 4 feet	[20] [____]	[30] [____]
e. of proposed subgrade elevation		
f. Paving area, below upper 4 feet	[30] [____]	[40] [____]
g. of proposed subgrade elevation		
h. Paving area, upper 4 feet	[20] [____]	[30] [____]
i. of proposed subgrade elevation		

- E. Provide material imported from off-site with CBR (California Bearing Ratio) or LBR (Limerock Bearing Ratio) value equal to or above pavement design subgrade CBR or LBR value indicated on Drawings.

3.04 MAINTENANCE OF SUBGRADE

- A. Verify finished subgrades for elevations indicated on Drawings and specified conditions for construction above subgrade.
- B. Protect subgrade from excessive wheel loading during construction, including concrete trucks and dump trucks.
- C. Remove areas of finished subgrade found to have insufficient compaction density. Replace in a manner that will comply with compaction requirements as directed by Architect. Provide hard, uniform, smooth, stable surface, true to grade and cross-section after completion of compaction.

3.05 PROTECTION

- A. Protect building subgrade pad and building related earthwork from damage by construction operations and erosion.
- B. Prohibit vehicles from entering building subgrade pad area. Vehicles not permitted.
- C. Scarify surface, reshape, and compact areas damaged by construction operations or weather erosion.

END OF SECTION 31 23 00

SECTION 31 25 00 - STORM WATER POLLUTION PREVENTION PLAN

PART 1 - GENERAL

1.01 SUMMARY

- A. This section will consist of the completion and implementation of a Storm Water Pollution Prevention Plan (SWPPP).

PART 2 - PRODUCTS

2.01 MATERIALS

- A. The Contractor shall comply with all requirements of authorities having jurisdiction for preparation of and compliance with storm water pollution prevention including but not limited to the EPA, TCEQ, the City of where project is located, and all authorities having jurisdiction.

PART 3 - EXECUTION

3.01 EXECUTION

- A. The Contractor will be responsible for preparation of, execution and implementation of the SWPPP, including construction of all required erosion control features, reporting other EPA and completion of inspection forms.
 - 1. SWPPP shall be prepared by licensed professional engineer in the State of Texas, or the state where the project is located, in compliance with requirements of authorities having jurisdiction.

END OF SECTION 31 25 00

SECTION 31 25 53 - SOIL EROSION AND SEDIMENT CONTROL

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes: This section specifies soil erosion and sediment control work during construction, as shown. The work includes, but is not limited to, furnishing and installing straw bales or silt fence to form dikes or to form ditch, basin, and drop inlet erosion check; constructing earth perimeter dikes and overflow outlets; constructing crushed stone sediment traps and earth embankments; constructing sediment basins; constructing silt fences; placing riprap; and, furnishing and installing seed or sod for erosion control.
- B. Related Sections include the following:
 - 1. Division 31 Section: Earthwork
 - 2. Division 31 Section: Excavation and Fill
- C. The work performed under this section shall comply with the Storm Water Pollution Plan for this Project and with the requirements and intent of the NPDES Storm Water Discharge Permit program.

1.03 QUALITY ASSURANCE

- A. The following Codes, Regulations, Reference Standards, and Specifications apply to work included in this section:
- B. Codes and regulation of the jurisdictional authorities, including the NPDES general permit for storm water discharges associates with the construction activity.
- C. "REFERENCE CODES AND STANDARDS":
 - 1. AASHTO: M-43 M182.
 - 2. ASTM: A112, A116, A584, C90, C140, C145, D4397.
 - 3. USDA: Soil Conservation Service Publication: Standards and Specifications for Soil Erosion and Sediment Control in Developing Areas.
 - 4. Sampling and testing concrete masonry units shall be in accordance with ASTM C140.

1.04 SUBMITTALS

- A. Submit the following for approval in accordance with Division 1 Section: "Submittal Procedures", and with the additional requirements as specified for each:
- B. Certification of each item listed in this section with the appropriate samples, manufacturer's specifications and catalogue information.
- C. Storm Water Pollution Prevention - Contractor Certification:
 - 1. Prior to commencement of construction activities, the Contractor shall submit to the City where the project is located, or to the Authorities having Jurisdiction, a signed copy of the following certification statement, to be filed with the Storm Water Pollution Prevention Plan (SWPPP):
 - 2. "I certify, under penalty of the law, that I understand the terms and conditions of the general National Pollutant Discharge Elimination System (NPDES) permit that authorizes the storm water discharges associated with industrial activity from the construction site, identified as part of this certification".

PART 2 - PRODUCTS

2.01 STRAW BALES

- A. Provide straw or hay bales approximately 36 inches long by 24 inches wide by 18 inches high; minimum 60 pounds, maximum 120 pounds each; bound with galvanized wire or nylon rope tied across stem lengths.

2.02 STAKES

- A. Provide nominal 2 inches by 2 inches wooden stakes with sharpened ends or minimum 1/2-inch diameter steel picket rebar. Stakes: approximately 3 feet in length.

2.03 CRUSHED STONE

- A. AASHTO M43: Size No. 2 or 24.

2.04 SEED AND SOD

- A. As specified in Division 32 Sections: "Landscape Seeding" and "Turf and Grasses".

2.05 APPROVED FILL

- A. Fill material for embankments, dikes, and erosion checks: as specified in Division 31 Sections: "Earthwork" and "Excavation and Fill".

2.06 TOPSOIL

- A. As specified in Division 32 Sections: "Landscape Seeding" and "Turf and Grasses".

2.07 JUTE MATTING (MESH)

- A. Provide jute matting of a uniform, plain weave with warp, and weft yarns of approximately the same size. The physical requirements shall be:
 - 1. Width: 45 inches to 48 inches, plus or minus one inch.
 - 2. 78 warp ends per width.
 - 3. 41 weft ends per yard.
 - 4. Weight - 1.80 lbs. (average) per running yard.

2.08 SILT FENCE MATERIALS

- A. Silt Fence Fabric:
 - 1. One of the following:
 - a. Burlap: AASHTO M182.
 - b. Polypropylene fabric: ASTM D4397.
 - c. Nylon netting reinforced fabric.
 - 2. Minimum bursting strength: 150 lbs.
 - 3. Edges treated to prevent unraveling.
 - 4. Furnished with O-rings or clips to facilitate attachment to woven wire fabric.
- B. Woven Wire Fabric: ASTM A116, Class 3 Coating; or ASTM A584, Class II Coating.
- C. Posts:
 - 1. Steel, T-section, minimum 4 feet 6 inches long, minimum of 1.3 lbs. per foot without anchor plate.
 - 2. Anchor plate attached before coating.
 - 3. Fabricated with lugs or other approved means to prevent vertical movement of the woven wire fabric.
- D. Coatings for Posts:
 - 1. Factory Painted:

- a. Prime coat: As specified in Division 09 Section: "Painting" for steel.
- b. Final Coat: Aluminum paint.
- E. Tie Wire: Galvanized in accordance with ASTM A112.

PART 3 - EXECUTION

3.01 CONDITION OF SUBSTRATE

- A. Examine the areas and conditions under which soil erosion and sediment control work is to be completed.
- B. Stabilize fill and grade of areas to receive soil erosion and sediment control. Maintain positive drainage to sediment and erosion control devices during and after grading operations.

3.02 STRAW BALE DIKE INSTALLATION

- A. Place bales in a row with ends abutting one another. Embed each bale in soil a minimum of 4 inches. Place anchor bales with two stakes driven through bales and sunk a minimum 1-1/2 feet into stabilized earth. Angle the initial stake toward previously laid bale to force bales together. Drive stakes flush with top bales. Remove bale dikes when no longer useful for controlling drainage and water flow.

3.03 STRAW BALE EROSION CHECK INSTALLATION

- A. Ditch Erosion Checks:
 - 1. Where ditches are cut into existing ground and side slopes, place ditch erosion checks, consisting of bales, across the ditch slope invert. Install at least two bales across the ditch invert. Install additional bales on the ditch slopes, as shown, or when directed. Stake two overlapping bales staked up each ditch side slope. Set overlaps tight to eliminate openings in the ditch erosion check.
- B. Basin and Drop Inlet Erosion Check:
 - 1. Where basins and drop inlets are located in the ditch line and off the paved areas, install baled straw erosion checks as shown. Protect entrance structures with straw bales staked upstream around drainage structure to ensure elimination add soil and silt from entering the underground drainage system. Stake one bale perpendicular to the flowline directly upstream from the inlet. Set two additional bales parallel to the flowline at each end of the bale. Stake all bales tightly against each other to eliminate any possible openings. Where shown, or when directed, embed the bales 4 inches into the ground around structures.
- C. When the buildup of soil and silt behind the baled soil erosion checks reaches a height of 12 inches or when the checks are no longer functioning efficiently, remove the accumulated material. Bales shall be replaced every three months to maintain effectiveness of the sediment control measure.
- D. Remove baled straw used for erosion checks when approved, or when the project is completed.
- E. In no cases shall bales be left in ditches and around drainage structures after all construction is finished.
- F. Curb Inlet Erosion Checks:
 - 1. Protect entrance structure with straw bales paralleled with the gutter flowline to ensure elimination of soil and silt from entering the underground drainage system.
- G. Shoulder Drain Erosion Check:
 - 1. Where ballast drains are installed before placement of ballast, the following shall be installed. Install straw bale erosion checks as shown. Protect entrance structure with

straw bales staked around ballast drain to ensure elimination of soil and silt from entering the underground drainage system. All bales shall be tightly staked against each other to eliminate any possible openings. All straw bales around ballast drains shall be removed just prior to installation of ballast.

3.04 PERIMETER EARTH DIKE AND OVERFLOW OUTLET INSTALLATIONS

- A. Construct dikes with suitable backfill material, machine compacted, with positive drainage to outlets. Divert runoff from protected and stabilized upland areas to outlets with stabilized soil or grade stabilization behind outlets. Divert runoff from disturbed and exposed upland area to sediment traps or basins. Level to grad both earth dikes and overflow outlets once the sod area has stabilized. Remove stones, roots, and other extraneous materials larger than 2 inches any dimension.
- B. Construct overflow outlets in perimeter earth dikes of compacted crushed stone embedded a minimum of 4 inches into the earth dikes. Construct the crest of outlets approximately 6 to 8 inches below height of adjoining earth dike.
- C. Remove overflow outlets from the site once the soil area has properly stabilized.

3.05 SEDIMENT TRAP AND EMBANKMENT INSTALLATIONS

- A. Construct sediment traps as shown on the drawings using crushed stone at outlets, existing backfill and soil materials for embankments, with stabilizing cores consisting of straw bales, concrete blocks, or timber.
 - 1. Clear, grub, and grade areas under embankments and trap outlets prior to placing embankments. Clear pool areas.
 - 2. Where used as core material for outlets and embankments, anchor straw bales in place with two stakes per bale. Drive stakes through bales and into stabilized soil a minimum of 1-1/2 feet.
 - 3. Place and compact embankment material.
 - 4. Place and compact crushed stone solidly over core at outlets. Crest of outlets shall be approximately 10 to 12 inches below height of adjoining embankment.
 - 5. Unless otherwise shown, construct cut and fill slopes at 3:1, or flatter.
 - 6. Place jute matting (mesh) over embankments as shown. Securely anchor matting with stakes or stays.
 - 7. When sediment has accumulated to 1/2 the design depth of the trap or 1 foot, whichever is less, remove sediment and deposit such material in a previously approved area which is free of erosion.
 - 8. Remove sediment traps and embankments once the soil area has been properly stabilized as determined by the Architect.
- B. Construct sediment basins in compliance with the "Standard and Specifications for Sediment Basin" as published by the U.S. Department of Agriculture Soil Conservation service in its volume "Standards and Specification for Soil Erosion and Sediment Control in Developing Area".

3.06 SODDING

- A. Perform sodding work when temperatures are 40 deg. F or higher. Do not place sod when ground surface is frozen or during extended drought.
- B. Loosen subgrade of areas to be sodded and apply topsoil mixture over the area.
- C. Lay sod within 20 hours from time of stripping.
- D. Peg sod on slopes as required to prevent slippage. Use 1 inch by 1 inch by 6 inch wooden pegs with one end sharpened.

- E. Provide fertilizer and soil amendments as required to maintain healthy sodded areas.
- F. Sod areas to the limits indicated on drawings.
- G. Stabilize channel flow areas disturbed by the Contractor's operations with specified sod. Sod invert of ditches to 2 feet above invert.

3.07 SEEDING

- A. Place and prepare topsoil as specified in Division 32 Sections: "Landscape Seeding" and "Turf and Grasses".
- B. Place seed and fertilize as specified in Division 32 Sections: "Landscape Seeding" and "Turf and Grasses".

3.08 SILT FENCE

- A. Install steel posts on a minimum of 8 foot centers. Minimum embedment of 1 foot 6 inches.
- B. Minimum height of the silt fence to be 2 feet 6 inches with a 6 inch clearance between the top of the silt fence and the top of the posts.
- C. Install the steel posts on a slight angle towards the anticipated runoff surface.
- D. Trench in the toe of the silt fence so that the downslope faces of the trench is flat and perpendicular to the lie of flow.
- E. Minimum trench depth: 6 inches.
- F. Trench width: 3 to 4 inches.
- G. Attach welded wire fabric to the posts.
- H. Attach the silt fence fabric to the welded wire fabric and secure with a minimum of two wraps.
- I. Backfill over the silt fence fabric.
- J. When build up of soil, silt, or any other material behind the silt fence reaches a height of 6 inches or when the fence is no longer functioning efficiently, remove all accumulated material. The accumulated material shall be disposed of as set forth in Division 01 Section: "Construction Waste Management".

3.09 CONTROL AND DISPOSAL OF EXCESS MATERIAL, TRASH, DEBRIS, AND EFFLUENT

- A. Dispose of excess excavated material that is approved by the Architect as clean fill if an onsite soil disposal areas has been approved. If no such site is approved, dispose of material in accordance with the provisions of Division 01 Section: "Construction Waste Management". Small amounts of material generated by excavation for fencing, etc. may be exempted from this provision. In all cases the provisions of Division 01 Section: "Construction Waste Management" apply to the onsite disposal of excavated material.
- B. Pick-up trash and place in containers. Empty containers on a regular schedule. Conduct handling and disposal to prevent contamination of the site and others areas. Do not dispose of in wetlands and do not burn on the Right-of Way (ROW). On completion, leave the disposal areas clean.
- C. Dispose of rubbish and debris as follows:
 - 1. Transport all waste off the site and dispose of in a manner that complies with State, and local requirements. Secure a permit or license prior to transporting any material off the site. Submit copies of approval documents from appropriate Authorities to the Architect prior to use of the disposal sites. Do not burn waste materials on site.

D. Effluent:

1. The Contractor shall take all necessary measures to assure compliance with the requirements of the NPDES Storm Water Discharge Permit obtained for this Project, and with the Storm Water Pollution Prevention Plan developed for this Project.

3.10 PROTECTION AND MAINTENANCE

- A. Protect erosion and sediment control devices from damage. Repair and replace dikes, erosion checks, sediment traps, silt fences, overflow outlets, and other measures when damaged by construction, natural, and other physical causes. All soil erosion and sediment control device shall be repaired or replaced at the expense of the contractor and shall function as originally intended.
- B. Periodically (at least once every 7 days and after each rainfall event) inspect and maintain erosion and sediment control structures, until final stabilization is achieved.
- C. Maintain sod by watering, fertilizing, weeding, mowing, and trimming. Replace sod which has been eroded, damaged by construction activities, deteriorated, or diseased.
- D. All stockpiled soil shall be surrounded by a straw bale dike or silt fence to properly control sediment runoff. All material and labor required to install and maintain the erosion control at soil stockpiles shall be included in the Contract.
- E. Inspection services provided by the project City's representative do not relieve the Contractor's responsibility for inspection and maintenance of the erosion control measures, or his duty to comply with the Storm Water Pollution Prevention Plan and the conditions of the NPDES General Permit.

3.11 ACCEPTANCE

- A. Soil erosion and sediment control devices will be acceptable, provided that they are in good condition and functioning as intended.
- B. Sodded areas will be acceptable, provided that all requirements, including maintenance, have been complied with, and a healthy, well-rooted, even-colored, viable sod is established.

3.12 STAGING AREAS

- A. At such time when the specific location of the staging areas are determined, silt fences, straw bale dikes, or equivalent sediment controls are required for all sideslope and downslope boundaries of the staging area or a detention basin providing storage for runoff from the staging area from a 10 year, 24-hour storm shall be provided. This erosion control plan shall be approved by the Architect and shall be in place prior to occupation of the staging areas. All relative material and labor to construct and maintain the staging area erosion control plan shall be subsidiary to the other items of work. Plan, schedule, and undertake work in a manner that will ensure protection and preservation of existing wetlands and water courses identified by the Corps of Engineers and the U.S. Fish and Wildlife Service

3.13 VEGETATIVE PRACTICES

- A. Temporary seeding, permanent seeding, mulching, or sod stabilization procedures, or their equivalent, must be initiated on all disturbed areas within 14 calendar days of last activity in that area. Temporary seeding, or sod and/or soil stabilization procedures will not be paid for directly, but will be considered subsidiary to the Contract. All permanent soil stabilization procedures shall be installed, measured, and paid for by the Contractor, and shall be in accordance with Division 32 Sections: "Landscape Seeding" and "Turf and Grasses".

END OF SECTION 31 25 53

SECTION 31 31 16 – TERMITE CONTROL

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. General Coordination Procedures, (Reference Specification Section 01 31 00) General Contractor shall coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work that depend on each other for proper installation, connection, and operation.

1.02 SUMMARY

- A. Section Includes: Furnish and install a chemical barrier to afford the structure protection from termites and other common ground insects
 - 1. Soil treatment for termite control.
- B. Related Sections include the following:
 - 1. Division 01, Section "Temporary Facilities and Controls", for pest control requirements during and at conclusion of construction period.
 - 2. Division 03, Section "Cast-In-Place Concrete"
 - 3. Division 06, Section "Rough Carpentry", for wood preservative treatment by pressure process.
 - 4. Division 07, Section "Vapor Barrier".

1.03 QUALITY ASSURANCE

- A. Comply with all applicable regulatory and environmental requirements.
- B. Installer Qualifications: A specialist who is licensed according to regulations of authorities having jurisdiction to apply termite control treatment and products in jurisdiction where Project is located and who employs workers trained and approved by manufacturer to install manufacturer's products.
 - 1. Any chemicals toxic to animals and plant life should be applied with caution by an experienced person who is licensed in accordance with the regulatory agency of the State.
- C. Regulatory Requirements: Formulate and apply termiticides and termiticide devices according to the EPA-Registered Label.
- D. Preinstallation Conference: Conduct conference at Project site.

1.04 SUBMITTALS

- A. Action Submittals: Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components, and profiles for termite control products.
 - 2. Include the EPA-Registered Label for termiticide products.
- B. Informational Submittals:
 - 1. Qualification Data: For qualified Installer.
 - 2. Product Certificates: For each type of termite control product.
 - 3. Sample Warranties.
- C. Closeout Submittals: Soil Treatment Application Report: After application of termiticide is completed, submit report for Owner's records and inclusion in O&M Manuals. Include the following:

1. Date and time of application.
2. Moisture content of soil before application.
3. Termiticide brand name and manufacturer.
4. Quantity of undiluted termiticide used.
5. Dilutions, methods, volumes used, and rates of application.
6. Areas of application.
7. Water source for application.

1.05 PROJECT CONDITIONS

- A. Environmental Limitations: To ensure penetration, do not treat soil that is water saturated or frozen. Do not treat soil while precipitation is occurring. Comply with requirements of the EPA-Registered Label and requirements of authorities having jurisdiction.
- B. Coordinate soil treatment application with excavating, filling, grading, and concreting operations. Treat soil under footings, grade beams, and ground-supported slabs before construction.

1.06 WARRANTY

- A. Soil Treatment Special Warranty: Manufacturer's standard form, signed by Applicator and Contractor, certifying that project has been registered with Manufacturer to meet the required Warranty criteria, provide termite control work for the duration of the Warranty, consisting of applied soil termiticide treatment, will prevent infestation of subterranean termites, including Formosan termites (*Coptotermes formosanus*) If subterranean termite activity or damage is discovered during warranty period, re-treat soil and repair or replace damage caused by termite infestation.
 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 SOIL TREATMENT

- A. Termiticide: Provide an EPA-Registered termiticide, complying with requirements of authorities having jurisdiction, in an aqueous solution formulated to prevent termite infestation. Provide quantity required for application at the label volume and rate for the maximum termiticide concentration allowed for each specific use, according to product's EPA-Registered Label.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Corporation, Agricultural Products; Termidor.
 - b. Bayer Environmental Science; Premise.
 2. Pest Control Contractors: Subject to compliance with requirements, acceptable applicators include but are not necessarily limited to:
 - a. Terminix
 - b. Orkin
 - c. Myers
 - d. Metrogard
 3. Service Life of Treatment: Soil treatment termiticide that is effective for not less than five years against infestation of subterranean termites.
- B. Materials shall be used, provided:
 1. They are determined to meet five (5) year test conducted by the U.S. Forest Service, or the U.S. Department of Agriculture.
 2. Evidence is provided indicating any toxic effects to humans, plants or animal life.
 3. Allowed by governing laws and/or ordinances.

PART 3 - EXECUTION

3.01 APPLICATION, GENERAL

- A. General: Comply with the most stringent requirements of authorities having jurisdiction and with manufacturer's EPA-Registered Label for products.

3.02 APPLYING SOIL TREATMENT

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for moisture content of soil per termiticide label requirements, interfaces with earthwork, slab and foundation work, landscaping, utility installation, and other conditions affecting performance of termite control.
- B. Proceed with application only after unsatisfactory conditions have been corrected.
- C. Soil Treatment Preparation: Remove foreign matter and impermeable soil materials that could decrease treatment effectiveness on areas to be treated. Loosen, rake, and level soil to be treated except previously compacted areas under slabs and footings. Termiticides may be applied before placing compacted fill under slabs if recommended in writing by termiticide manufacturer.
 - 1. Fit filling hose connected to water source at the site with a backflow preventer, complying with requirements of authorities having jurisdiction.
- D. Application: Mix soil treatment termiticide solution to a uniform consistency. Provide quantity required for application at the label volume and rate for the maximum specified concentration of termiticide, according to manufacturer's EPA-Registered Label, to the following so that a continuous horizontal and vertical termiticidal barrier or treated zone is established around and under building construction. Distribute treatment evenly.
 - 1. Slabs-on-Grade and Basement Slabs: Under ground-supported slab construction, including footings, building slabs, and attached slabs as an overall treatment. Treat soil materials before concrete footings and slabs are placed.
 - 2. Foundations: Adjacent soil, including soil along the entire inside perimeter of foundation walls; along both sides of interior partition walls; around plumbing pipes and electric conduit penetrating the slab; around interior column footers, piers, and chimney bases; and along the entire outside perimeter, from grade to bottom of footing. Avoid soil washout around footings.
 - 3. Masonry: Treat voids at masonry that rest on footings below grade.
 - 4. Penetrations: At expansion joints, control joints, and areas where slabs will be penetrated.
- E. Avoid disturbance of treated soil after application. Keep off treated areas until completely dry.
- F. Post warning signs in areas of application.
- G. Protect termiticide solution, dispersed in treated soils and fills, from being diluted until ground-supported slabs are installed. Use waterproof barrier according to EPA-Registered Label instructions.
- H. Reapply soil treatment solution to areas disturbed by subsequent excavation, grading, landscaping, or other construction activities following application.

END OF SECTION 31 31 16

SECTION 31 32 13 - LIME SOIL STABILIZATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Lime mixing (dry or slurry) into the subgrade for stabilization.
- B. Related Sections include the following:
 - 1. Division 31 Section "Earthwork."

1.03 SCOPE

- A. Furnish labor, materials, services, equipment and appliances required for lime stabilized paving sub-base work indicated on the drawings and specified herein.
- B. Provide a completed course of treated material containing a uniform lime mixture, free from loose or segregated areas, of uniform density and moisture content, well bound for its full depth and with a smooth surface suitable for placing subsequent courses. Contractor is responsible to regulate sequence of work, to use proper amount of lime, maintain the work and rework as necessary to meet above requirements.

1.04 STANDARDS

- A. Meet requirements and recommendations of applicable portions of:
 - 1. American Society for Testing Materials (ASTM);
 - 2. American Association of State Highway Officials (AASHO).

1.05 SUBMITTALS

- A. Submit manufacturer's certificate indicating lime to be furnished meets specified requirements.

1.06 TESTING LABORATORY SERVICES

- A. The Owner shall pay for the services of a qualified soils laboratory to provide testing for this section, and shall be done as per the Geotechnical Report, and as follows:
 - 1. Qualified soils personnel on site for stabilization inspection.
 - 2. The laboratory representative shall take samples and make adequate inspections to determine that the proper soil stabilization has been obtained.
 - 3. The lab shall furnish a complete report showing :
 - a. Plasticity Index for Lime Stabilized Soil Mixture per ASTM D2217.
 - b. Lime quantity tickets.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Lime: One of the following based on "Mix" determined for use:
 - 1. Type "A": Hydrated lime; dry power consisting of calcium hydroxide or a mixture of calcium hydroxide and small amounts of calcium oxide, magnesium oxide and magnesium hydroxide. Content by weight:

- a. Calcium Hydroxide (Active Lime): Min. 90%.
 - b. Calcium Oxide (Unhydrated Lime): Max. 5%.
 - c. Free Water: Max. 4%.
 - 2. Type "B": Commercial lime slurry; pumpable suspension of solids in water; solids portion of mixture consisting principally of hydrated lime. Content by weight:
 - a. "Solids" Hydrate Alkalinity: Min. 87%.
- B. Water: City tap water.

2.02 EQUIPMENT

- A. Suited for purpose intended. Maintain equipment in good operating condition.

2.03 MIX

- A. Contractor employ and pay for, as part of contract price, the services of an Owner-acceptable independent testing laboratory to determine mix required to achieve a plasticity index of 15 or less and to comply with requirements specified hereinafter. Include type and quantity of lime, application rates, equipment types, placing and mixing procedures, and curing. Seven percent lime content by volume is minimum (THD Item 264, COG Item 4.6) requirement of these specifications.

PART 3 - EXECUTION

3.01 DELIVERY AND STORAGE

- A. Deliver in unopened containers clearly marked with certified weights. Store in weatherproof containers, bins or buildings.

3.02 INSPECTION OF SUBGRADE

- A. Inspect subgrade for compaction of fill and surface tolerances. Do not begin stabilization until subgrade is acceptable.

3.03 PREPARATION

- A. Scarify subgrade to depth shown on drawings for sub-base. Correct unstable material below required depth by proper compaction.
- B. Lime Application: Use either "Dry Placing" or "Slurry Placing" method. Distribute uniformly over scarified subgrade at rate required by "Mix". Place only the amount of area to allow first mixing operation to be completed the same working day:
- 1. Dry Placing: Use screw type spreader box or bag distribution. Do not spread with maintainer or motor grader. Do not place lime during windy or other adverse weather conditions. Sprinkle until proper moisture content has been secured.
 - 2. Slurry Placing: If type "A" lime is to be used as slurry, mix lime with water in trucks. Place slurry using acceptable distributor. Make successive passes over measured section of area to be treated until proper lime and moisture content as determined by "Mix" has been secured. Furnish truck with approved agitator which will keep lime and water uniformly mixed. Do not change grade of slurry without prior acceptance.
 - 3. Mixing: Procedure is the same for either "dry placing" or "slurry placing". Mix until uniform mixture and moisture content is achieved.
 - a. First Mixing: Thoroughly mix soil and lime to required depth, using pulver-type mixer. mix until homogeneous, friable mixture of lime and soil is obtained, free of clods or lumps. Add proper moisture and cure as directed by "Mix". Keep moist during curing period.
 - b. Final Mixing: After curing, uniformly mix soil and lime using pulver-type mixer. Reduce size of clods or lumps by pulverization.

4. Compaction: Begin compaction immediately after final mixing. Provide optimum moisture during compaction. Begin at bottom and compact until entire required depth is uniformly compacted. Compact treated material in such a manner that it will not be mixed with underlying material. Correct irregularities or weak spots immediately by replacing material and recompact. Maintain surface in smooth condition until pavement is placed. Acquire density of at least 95% of standard density at optimum moisture content of treated material; AASHTO Standard T-99 or ASTM D698-66T at its optimum moisture content to 4% above its optimum moisture content. Use pneumatic-type roller for final surface rolling.
5. Curing: Moist-cure compacted subgrade section for minimum of 7 days before placing paving.

3.04 CLEAN-UP

- A. Upon completion of work of this section, remove related debris from premises.

END OF SECTION 31 32 13

SECTION 31 32 23 - WATER AND LIME PRESSURE INJECTION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Water and Lime mixture
 - 2. Equipment
 - 3. Installation procedures
- B. Related Sections include the following:
 - 1. Division 01 Section "Geotechnical Report."
 - 2. Division 01 Section "Testing."
 - 3. Division 31 Section "Earthwork."
 - 4. Division 31 Section "Drilled Piers."

1.03 SCOPE

- A. Provide lime-slurry pressure-injection stabilization to obtain a relatively uniform, moist, stable zone of soil beneath slab-on-grade. This work shall be performed after completion of grading and prior to the placement of select fill or drilled piers.
- B. The Contractor shall furnish all labor, equipment and materials to perform pressure injection of water and lime slurry beneath the structure as described below.

1.04 STANDARDS

- A. Meet requirements and recommendations of applicable portions of Standards listed.
 - 1. American Society for Testing and Materials
 - 2. North Texas Council of Governments.

1.05 QUALITY ASSURANCE

- A. Applicator: Minimum of two years of experience using pressure injection process.

1.06 SUBMITTALS

- A. Submit data on proposed methods and equipment for lime slurry pressure injection process.
- B. Submit invoices or delivery tickets to verify exact quantity of lime utilized.

1.07 JOB CONDITIONS

- A. Coordinate lime slurry injection with building pad earthwork.
- B. Do not inject materials when ambient temperature is 40° F and falling.

1.08 INSPECTION AND TESTING

- A. A full-time inspector, working under the supervision of a professional geotechnical engineer, will be retained by the Owner to check the specific gravity of the lime slurry, observe the injection operations, record quantities of materials used, coordinate testing of the injected area(s), and other duties as required.

- B. After a minimum curing time of 24 hours upon completion of the second water pass, the injected area will be tested as required to determine if additional injections with water are necessary. Tests will include moisture content, Atterberg limits, swell / absorption pressure, and other tests, as required, on samples obtained from soil borings drilled in representative injected areas. Test boring should be performed to depths of 10 feet at a spacing of one boring per every 7,400 square feet injected. Samples should be obtained at 1 foot intervals and tested in accordance with general practice for lime slurry treated soils.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Hydrated Lime: Applicable parts of ASTM C977.
- B. Water: Potable.
- C. Surfactant: Biodegradable, non-ionic detergent.

MIXES

- D. Proportion lime slurry at rate of 2-1/2 to 3 lbs. of hydrated lime per gallon of water. Continuously agitate.
- E. Specific Gravity Range: 1.15 to 1.18 at 68° F.
- F. Add surfactant to mix at rate of one undiluted gallon per 3,500 gallons of slurry or as recommended by the manufacturer.

2.02 EQUIPMENT

- A. Mixers:
 - 1. Slurry Tank: Capacity required for initial mixing of minimum load of bulk lime and equipped with mechanical agitators.
 - 2. Secondary Tank: Equipped for continuous mechanical agitation.
- B. Injection:
 - 1. Pumps: Shall be capable of pumping at least 3,000 GPH at 50 - 200 psi to supply continuous flow of slurry at specified pressures.
 - 2. Pressure Gauges: Calibrated to show pressure in pounds per square inch.
 - 3. Hoses: Capable of functioning within specified pressures with minimum inside diameter of 1-1/2" to supply four injection nozzles and 1" for two injection nozzles.
 - 4. Injection Nozzles: Galvanized schedule 40 steel pipe, minimum diameter 5/8" with hole pattern that will uniformly disperse lime slurry in a 360° radial pattern throughout entire depth.
 - 5. Injection Equipment: Mobile unit capable of forcing injection pipes into soil with minimum lateral movement. Unit shall be rubber tire or track machine suitable for the purpose intended.

PART 3 - EXECUTION

3.01 INSPECTION

- A. Verify that building sub-grade has been cut and filled to the required depth below bottom of finished slab prior to starting pressure injection.
- B. Inspect sub-grade for defects that would prevent proper application of lime injection.

3.02 INSTALLATION

- A. Perform pressure injection prior to installation of building pad select fill and prior to installation of footings, piers, beams and underground piping.
- B. Continuously agitate slurry during injection. Maintain same specific gravity at slurry mixer tank and injection nozzles. Contractor shall provide hydrometer or other suitable measuring tools to accurately verify slurry mixes.
- C. Adjust injection pressures to dispense as large a volume of lime slurry as possible within a range of 50 to 200 psi.
- D. Space injection holes at 5' o.c. maximum in each direction and extend a minimum of 5' beyond building limits. Allowance should be made for 2" to 4" of swelling as a result of the injection process.
- E. Force injector pipes downward, in approximately 12" increments, injecting to refusal at each interval, for a total depth of 10 feet, or to material that cannot be penetrated by two injection rods mechanically pushed into the soil by an injection machine weighing a minimum of five tons.
- F. The average moisture content of the stabilized soils shall be a minimum of one half the liquid limit after injection, and will be verified by sampling and testing to a depth of 10 feet.
- G. Inject at each interval to "refusal" (i.e., until the maximum quantity of slurry has been injected into the soil and slurry is running freely at the surface, from areas where the surface soils have fractured), or until a maximum of 7 pounds of hydrated lime per square foot of treated areas has been installed, whichever comes first.
- H. The quantity of lime injected shall be closely monitored on a daily basis by the lime slurry contractor foreman and the geotechnical inspector in an effort to achieve a uniform distribution throughout the treated area. The total tons of lime to be injected shall be determined as follows:
 - 1. Verify from certified delivery tickets or from quicklime Slaking Batch Reports which calculate the weight of hydrate produced based on weight and purity of the quicklime slaked.
 - 2. If the total tons injected is less than the specified amount, re-inject the deficient amount of lime uniformly over the entire treated area or around the perimeter of the treated area starting on the uphill side.
 - 3. The second pass of lime can be performed immediately after the first pass of lime, however, 24 hours should lapse between the beginning of the water injection pass.
- I. Following completion of the lime injection work specified above, the entire building area and five feet outside the building limits shall be injected with water and surfactant in the same manner and to the same total depth as specified for the lime injection.
- J. Injections shall be made in approximately 12" - 18" intervals from the surface down to the specified depth, injecting to refusal at each interval. The total number of water injection passes and amount of water required will be determined by the soils engineer upon completion of laboratory testing.
- K. A minimum of 24 hours should be allowed between all injection passes and between the beginning of any additional testing.
- L. After waiting a minimum of 24 hours, the building pad area will be injected additional times. The injection holes on additional passes shall be orthogonally offset 2.5 feet from the previous injection pass.
- M. After treatment, mix free lime on surface into soil, then re-compact surface to a minimum of 95% of standard Proctor density at or above optimum moisture content as determined by ASTM D698.

- N. Continuous inspection of the injection procedures by a representative of the testing laboratory is required.

END OF SECTION 31 32 23

SECTION 32 13 13 - CONCRETE PAVING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Provide concrete paving including broom finished paving and walks, curbs and gutters. Restore paved areas opened or damaged in performance of the work required by the Contract Documents.
- B. Related Sections include the following:
 - 1. Division 1 Section "Laboratory Testing."
 - 2. Division 3 Section "Concrete Formwork."
 - 3. Division 3 Section "Cast-in-Place Concrete."
 - 4. Division 7 Section "Joint Sealants."
 - 5. Division 31 Section "Earthwork."

1.03 SUBMITTALS

- A. Division 1 Section - Submittal Procedures: Procedures for submittals.
- B. Concrete Design: Contractor shall be responsible for and shall pay for design of concrete mixes. An independent testing laboratory shall determine design mixes of each type concrete based on specified strengths and materials in accordance with ACI 318-89. Submit 4 copies of each design mix for approval.
- C. Division 01 Section - Submittal Procedures: Procedures for submittals.
 - 1. Product Data: Submit product data for the following:
 - a. Joint filler.
 - b. Joint sealant.
 - c. Concrete admixtures.
 - d. Concrete curing compounds.
 - 2. Assurance/Control Submittals:
 - a. Concrete Mix Design: Submit three copies of each proposed mix design for each class of concrete in accordance with ACI 301, Sections 3.9 "Proportioning on the basis of previous field experience or trial mixture", or 3.10 "Proportioning based on empirical data". Submit separate mix design for concrete to be placed by pumping, in addition to the mix design for concrete to be placed directly from the truck chute.
 - b. Include the following information in concrete mix design:
 - 1) Proportions of cement, fine and coarse aggregate, and water.
 - 2) Water-cement ratio, 28-day compressive design strength, slump, and air content.
 - 3) Type of cement and aggregate.
 - 4) Aggregate gradation.
 - 5) Type and dosage of admixtures.
 - 6) Special requirements for pumping.
 - 7) Range of ambient temperature and humidity for which design is valid.
 - 8) Special characteristics of mix which require precautions in mixing, placing, or finishing techniques to achieve finished product specified.

1.04 QUALITY ASSURANCE

- A. Perform work in accordance with ACI 301.
- B. Conform to ACI 305R when mixing and placing concrete during hot weather.
- C. Conform to ACI 306R when mixing and placing concrete during cold weather.
- D. Regulatory Requirements:
 - 1. Conform to applicable requirements for paving work on public property.
 - 2. Contractor shall maintain access for vehicular and pedestrian traffic as required for other construction activities. Utilize temporary striping, flagmen, barricades, warning signs, and warning lights as required.

1.05 COORDINATION

- A. Notify responsible trades of schedules of concrete pours so as to allow adequate time for installation of their work.

1.06 STANDARDS

- A. American Society for Testing Materials (ASTM).
- B. American Concrete Institute ACI-617 "Standard Specifications for Concrete Pavement and Bases". ACI-396 "Manual of Standard Practice for Detailing Reinforced Concrete".

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Portland Cement: ASTM C-150-78a, Type I or III.
- B. Fine Aggregate: Natural sand, ASTM C-33-78.
- C. Coarse Aggregate: Hard, durable natural gravel or crushed rock meeting requirements of ASTM C-33-78. Maximum size and gradation in accordance with Size No. 67 or 467 in Table II of ASTM C-33.
- D. Grading: ASTM C-136.
- E. Water: Potable.
- F. Reinforcing Steel: ASTM A615, grade 60 or as noted on drawings.
- G. Dowels and Sleeves: 3/4" plain round bars, with plastic sleeve at one end, 24 inches long, allowing one inch of movement. Refer to drawings.
- H. Forms: Nominal 2" thickness dimension fir, or steel paving forms.
- I. Premolded Expansion Joint Filler: ASTM D-994, asphaltic.
- J. Dispersing Admixture: Cement-dispersing, water reducing compound complying with ASTM C-494 such as Pozzolith 100 series, as made by Master Builders.
- K. Curing Compound at Standard Paving: ASTM C-309, No. 40W by A. C. Horn Co., Kure-N-Seal by Sonneborn or Clear Bond by Guardian Chemical.
- L. Air Entraining: ASTM C-0260 by Master Builders or equal.
- M. No fly ash will be permitted.
- N. Color admixture: At locations indicated on drawings provide integrally colored concrete. Admixture shall be "Chromix" by L.M. Scofold Co., color as selected by Architect.
- O. Curing Compound at integrally colored concrete: color matched curing compound compatible with integral coloring product. Curing compound shall be "Color Wax" by L.M. Scofold or approved equal, color as selected by Architect.

2.02 PROPORTIONING AND MIXING

- A. Proportions and Design: Concrete shall produce a mixture of adequate workability, free from segregation, honeycombing and bleeding, and shall be of following types:
1. Schedule of Types of Concrete:

Type	Min. All. Comp.	Cement %	Air	Aggregates	Max. Size of
Type	Strength (28 days)		Gray P		
I	3500 psi			5%	1-1/2"
 2. Locations of Types of Concrete: Broom finish all paving. Sidewalks shall be 4" thick and paving shall be 6" thick at parking and 7" thick where subject to truck traffic as noted on drawings.
 3. Admixture: Add specified cement-dispersing agent, color admix (where specified) and air-entraining agent to concrete mixes.
- B. Mixing: Ready mixed concrete in accordance with ASTM C-94-67.
- C. Slump: Shall not exceed 5" or less than 3" per ASTM C-143.
- D. Air Entrainment: Air content by volume as per ASTM C231 shall be 5% to 7% based on measurements made in concrete mixtures at point of discharge at job site.

PART 3 - EXECUTION

3.01 INSPECTION AND PREPARATION

- A. Inspect subgrade and report any discrepancies to Architect before proceeding.

3.02 FORMWORK

- A. Build forms to lines and grades detailed, of sufficient strength and rigidity so they will not deflect under pressure of wet concrete. Exercise extreme care in layout, bracing, and aligning forms. Formwork shall be straight, with no bulges in completed work greater than 1/8" in 10 feet.

3.03 REINFORCING

- A. Place reinforcing steel as detailed and in accordance with ACI 318-89. Place wire mesh to provide one full mesh lap at sides, minimum 8" at ends. Lap bars 36 bar Diameters. Metal chairs shall be used to hold reinforcing steel in the proper plane. Place dowels and sleeves at expansion joints at 24" O.C. maximum. Refer to drawings.

3.04 PLACING

- A. Concrete: Convey and place concrete so there is no separation of ingredients in accordance with applicable requirements of Chapter 10 ACI Standard Specifications for Concrete Pavements and Concrete Bases (ACI 617-Current Edition). Do not place concrete when temperature is below 40 degrees F. No calcium chloride shall be added to the concrete. Do not place concrete which exceeds 95 degrees F., and add a retarder, if required, to all concrete which is between 90 and 95 degrees F. Ice shall be used to control the maximum temperature.
- B. Construction Joints: Stoppage of concrete placing shall occur at expansion joint or other detailed contraction joints. Construct bulkheads to permit continuation of reinforcing steel.
- C. Expansion Joints: Place 1/2" asphaltic expansion joint material where paving abuts existing paving, structure, walls or fixed objects. Place at every 60 feet each way in paving, every 30 LF in curbs and walks and at other locations detailed. Provide 1/2" wide expansion joint filler between curbs and concrete paving. Provide removable tacked-on strips to provide a recess for joint sealing compound. 3/4" Dowels, 24" long shall be placed at 24" O.C. through

expansion joints, sleeved one side, at all expansion joints except where joint abuts building, unless noted otherwise.

- D. Saw-Cut Contraction Joints: Saw-cut joints when concrete is hard enough not to be torn, raveled, or damaged by saw cutting equipment and no later than 10 hours after concrete placement. Trial cuts shall be made prior to execution. Use a power drive concrete saw. Saw blades shall make a clean, smooth cut, producing a groove 1/8" to 1/4" wide to depth required (1/4 slab depth). Locate contraction joints nominally at 12'-0" O.C., unless specified otherwise on Drawings. All joints shall receive sealant.

3.05 FINISHING

- A. Materials exposed to view free of surface defects such as poor joints, ridges, cracks, honeycombing, excessive laitance, stone pockets or other defects. Materials that are defective and cannot be satisfactorily repaired, removed and replaced at the Contractor's expense.
- B. Concrete cured by use of curing compound applied after surfaces take initial set after finishing. Use color matched curing system as recommended by manufacturer of integral color at colored concrete.
- C. General Paving and standard Sidewalks: Finish surface to gritty texture with stiff bristle push broom using straight continuous strokes. Finish all edges smooth with 1/8" to 1/4" radius.
- D. Ramps: Sawcut tactile warning surface to pattern indicated on drawings. Grooved shall be arranged so as to not hold water.
- E. Vibrate, screed and float concrete to level and test the surface, which shall not vary over 1/4" in 10' when tested with a ten foot straight edge.
- F. Finish all vertical surfaces in a manner that leaves the exposed surfaces free of honeycombing and form marks. Any damaged surfaces shall be repaired and stone rubbed to match adjacent finished surfaces.

3.06 CURING

- A. Apply a white-pigmented type curing compound at a uniform rate of approximately 200 SF/Gallon, or as recommended by curing compound manufacturer as soon as the finishing operation has been completed and the concrete has lost its water sheen. The curing procedure must protect the concrete, including all exposed surfaces against loss of moisture and rapid temperature change for a period of not less than four days from the beginning of the curing operations and without damage to, or marking of the finished concrete surface. Traffic shall not be allowed on finished concrete of a minimum period of seven days.
- B. At colored concrete apply color matched curing system as recommended by the manufacturer.

3.07 CLEANING

- A. Concrete approaches, sidewalks, and related work shall be hosed down with water, scrubbed with fiber brushes, allowed to dry and be left broom clean and in condition acceptable to the Owner.

END OF SECTION 32 13 13

SECTION 32 17 00 - PAVEMENT SPECIALTIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Parking barriers.
 - 2. Precast concrete curbs.
 - 3. Striping & directional paint markings.
 - 4. Precast Concrete Bollard Caps for Steel Pipe Bollards.
- B. Related Sections include the following:
 - 1. Division 03 Section- "Concrete".
 - 2. Division 32 Section - "Paving".
 - 3. Division 32 Section - "Unit Paving".

1.03 GENERAL

- A. Furnish all labor, materials, services, equipment and appliances required for pavement specialty work indicated on the drawings and specified herein.

1.04 JOB CONDITIONS:

- A. Condition of pavement: Clean, dry and cured minimum amount of time as recommended by striping paint manufacturer.

1.05 SUBMITTALS

- A. Submit manufacturer's literature to the Architect for approval. Literature shall show compatibility of product proposed for use with paving surface to which product is to be applied.
- B. Samples for initial selection: Manufacturer's standard selector samples or printed material showing accurate color rendition, for warning mats and concrete bollards.
- C. Shop Drawings: Show footing design, and attachment details of pavement specialties to adjacent construction. Include dimensioned site plan for location of bollards and detectable mats, coordinated with Contractor's field-verified dimensions.

1.06 COORDINATION OF WORK

- A. Contractor and subcontractor for work of this section shall be jointly responsible for the coordination of the work specified herein, including but not limited to:
 - 1. Fire Lanes: Coordinate with all governing authorities to determine exact requirements (whether or not shown on the drawings). Fire lane marking, if required, is part of the work of the base contract.
 - 2. Handicapped Parking Spaces: Coordinate with all governing authorities to determine exact requirements (whether or not shown on the drawings). Special marking, if required, is part of the work of the base contract.
 - 3. Colors: Coordinate color requirements with all governing authorities, use only acceptable colors. Colors specified herein shall be used, if acceptable.

4. Notification: Notify the Owner of any required variation from the drawings resulting from coordination.

1.07 PROTECTION

- A. Protect newly painted surfaces from damage by vehicles during the time required for paint to harden sufficiently to withstand traffic. Any damage to newly painted markings due to the paint subcontractor's failure to provide adequate protection shall be repaired by him at no additional cost to the Owner.

1.08 GUARANTEE

- A. Pavement Markings:
 1. Any work found to be defective due to poor workmanship or defective materials within a 60-day evaluation period from Substantial Completion will immediately be replaced at no additional cost to the Owner. A new 60-day evaluation period will commence upon repair. Contractors One-Year corrective period shall also be enforced as a remedy by Owner for continued deteriorating paint installation.
 2. Indications of defective work for the purpose of this guarantee include poor adhesion to the pavement surfaces, checking, cracking, peeling and discoloration. This shall not be construed to include wear, damage or discoloration caused by traffic, erosion or from normal exposure to the elements.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. Parking Barriers: Precast concrete, semicircular or beveled square in cross-section 6" high x 8" wide x 6'-0" long with holes for minimum anchoring dowels.
- B. Pre-Cast Concrete Bollard Caps: Pre-cast concrete bollard caps with anchors equal to TopGard "Pipe Bollard Caps". Size(s) to match steel pipe bollard sizes indicated. Provide at all new bollards unless otherwise noted
- C. Striping & Directional Marking Paint: Acrylic parking lot and/or street marking paint, recommended by manufacturer for type of surface.
 1. Paint type: Acrylic, water-borne pavement marking paint conforming to Texas Dept. of Highways Special Specification Traffic paint.
 2. Color:
 - a. General Use Striping, Directional Marking, & H.C. Marking: Manufacturer's standard flat white.
 - b. At line striping in drive aisles that is located between opposite directions of traffic, use traffic yellow.
 - c. Fire Lane Striping: Manufacturer's standard red or as per city code. Fire lane striping shall have lettering stenciled in white at 35' intervals, to read: "NO PARKING-FIRE LANE", or as required by local fire codes and regulatory authorities.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Removal of existing pavement markings: Where indicated in plan, and as inferred by new striping shown in areas of existing striping, remove existing striping completely by sand blasting or other method acceptable to Engineer and that will cause negligible damage to existing paving and surface texture. Power wash and clean paving to prepare surface for new pavement markings in accordance with paint manufacturer's recommendations.

- B. New concrete surfaces will be allowed to cure for a period of not less than 11 days before application of marking materials.
- C. Dust, clay, silt and excess sand will be removed (by sweeping) from the pavement to be marked before application of paint. If dirt and construction debris can not be adequately removed to ensure proper adhesion of paint by sweeping only, then power wash the entire area of paving to be striped and allow to dry thoroughly before paint application.
- D. Prior to beginning work, confirm requirements of regulatory authorities for pavement markings including colors. Where TxDOT or other authority has jurisdiction, confirm their requirements. Locate the fire lane striping on horizontal paving surface or on entire concrete curbs as required by local authorities. Where fire lanes are painted in a radiused arc across drive aisle, confirm acceptable radius dimension with local authorities for fire lane striping.

3.02 INSTALLATION:

- A. Equipment: Spray mechanism capable of applying paint at the rate specified at an even and uniform thickness, with clear cut edges. Mechanism shall be operated by means of quick opening and closing valves conveniently located.
- B. Striping & Marking:
 - 1. Where pavement is trowel or wood float finish concrete, lightly sandblast immediate area to receive striping prior to application of paint.
 - a. Rough broom finish areas will not require sand-blasting.
 - 2. Apply paint in accord with manufacturer's written instructions. Apply at a rate of one gallon spread evenly over an area of 105 SF± five square feet and a wet film thickness of 0.015 inch (15 mils.).
 - 3. Paint 4" wide lines in patterns and spacing as shown on drawings. Width of the lines shall be within a tolerance of one-half inch. The centerline of marking shall not deviate more than one-half inch laterally from a straight line at any point.
 - 4. Parking Striping:
 - a. Painted lines: 4" wide, generally 20' long, and spaced approximately 9' O.C. except where noted or local authorities require otherwise.
 - b. If the overall space divides equally into slightly larger spacing than 9', individual spaces should be increased equally, but should not in any case be less than 9' O.C., unless noted otherwise on drawings.
- C. Parking Barrier: Drill hole through pavement surface for steel rods to secure barrier in place. Barrier shall be centered between paint stripes. Minimum 2 #5 rods per barrier extended below paving surface and countersink 1/2" below top surface of barrier. At asphalt paving, extend 24" below paving.
- D. Pre-Cast Concrete Bollard Caps for Pipe Bollards: Install according to Manufacturer's installation instructions.

3.03 CLEANING

- A. Any spilled paints shall be cleaned from the paved areas to the satisfaction of the Owner. Keep the premises clean at all times.
- B. Paint, empty containers, and other materials or equipment shall not be stored or allowed to accumulate on, or near the paved areas.
- C. Upon completion of work of this section remove related debris from premises.

END OF SECTION 32 17 00

SECTION 32 31 12 - CHAIN LINK FENCING AND GATES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Furnish all labor, materials, services and equipment required for chain link fence and gate as shown on the drawings and as herein specified.
 - 2. Motorized gate operators.
- B. Related Sections include the following:
 - 1. Division 03 Section "Concrete", concrete for footings.
 - 2. Division 05 Section "Metal Fabrications", for welded tube steel gate frames and perforated metal infill panels.
 - 3. Division 8 Section "Door Hardware" for panic devices
 - 4. Electrical, for coordination with electrical wiring to gate hardware.
 - 5. Division 31 Section "Earthwork" for coordination with site grading.
 - 6. Division 32 Section "Decorative Metal Fencing and Gates".

1.03 REFERENCE STANDARDS

- A. Underwriter's Laboratories (UL):
 - 1. UL325, Doors, Drapery, Gates, Louvers, Windows, Operators, and Systems.
- B. American Society for Testing and Materials (ASTM):
 - 1. ASTM A 90 - Tests for Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles.
 - 2. ASTM A 116 - Specification for Zinc-Coated (Galvanized) Steel Woven Wire Fence Fabric.
 - 3. ASTM F 1184 - Specification for Industrial and Commercial Horizontal Slide Gates, Type II, Class 2.
 - 4. ASTM A 123 - Specification for Zinc (Hot- Dip Galvanized) Coatings on Iron and Steel Products.
 - 5. ASTM A 392 - Specification for Zinc-Coated Steel Chain-Link Fence Fabric.
 - 6. ASTM F 567 - Standard Practice for Installation of Chain Link Fence.
 - 7. ASTM A 824 - Specification for Metallic-Coated Steel Marcellled Tension Wire Use with Chain Link Fence.
 - 8. ASTM F 1043 - Specification for Strength and Protective Coatings on Metal Industrial Chain Link Fence Framework.
 - 9. ASTM F 900 - Specification for Industrial and Commercial Swing Gates.
 - 10. ASTM F 1083 - Specification for Pipe, Steel, Hot-Dipped Zinc Coated (Galvanized) Welded, For Fence Structures.
 - 11. ASTM F 2200 - Specification for gates to be automated.
- C. Chain Link Fence Manufacturer's Institute (CLFMI): Product Manual, most current version.

1.04 DEFINITIONS

- A. Entrapment Area: An area that has any one dimension that is greater than 4 inches or less than 16 inches where a person or body part can become caught or trapped between an automated gate or component of the gate and any fixed stationary object.
- B. Protrusions: Any object less than 9 square inches of cross sectional area attached to the gate, with a surface that extends behind the extreme horizontal planes created by the gate structure members.
 - 1. Exceptions for certain hardware are allowed by code and reference standards. Contractor shall comply with requirements as part of delegated design.

1.05 QUALITY ASSURANCE AND DELEGATED DESIGN

- A. Source Limitation: Provide chain link as manufactured by a single supplier, including necessary erection accessories, fittings, and fastenings.
- B. Installer Qualifications: Fencing by company specializing in commercial / institutional quality chain link fencing with minimum five years experience.
- C. Engineering Design for Fencing and Gates:
 - 1. Design framework and fittings to fit dimensions and loads indicated by use. Design in accord with values assigned by most restrictive industry guidelines.
 - 2. Where required by authorities having jurisdiction, design and construct fencing and gates to comply with design standards of controlling authorities. Obtain and pay for all associated permits.
- D. Chain link fencing work performed in conformance with Chain Link Fence Manufacturer's Institute standards.
- E. Gate Operator Installer Qualifications: Where required by state law or other authority having jurisdiction, installer shall be a licensed automated vehicular gate operator installer.
- F. Design, construct, and install automated gates to meet the requirements of UL 325, ASTM F2200, and to the requirements of local code enforcement having jurisdiction. Automated gate systems that do not meet the requirements of these systems shall not be allowed.
 - 1. In the event of conflict between gate configurations indicated in the Drawings, and the requirements of codes and reference standards, inform Architect of all conflicts to confirm resolution.
- G. Delegated Design Criteria for motorized gates and operators: Design gates to meet reference standards, and the following:
 - 1. Protrusions: Design and install gates without protrusions, except for hardware allowed to protrude as specifically permitted by code and reference standards.
 - a. Vertical and Bottom Edges: Protrusions at leading and trailing edges of gates, and at bottom edge of gates, shall not exceed 1/2 inch and shall be smooth on all surfaces with no sharp edges.
 - b. Protrusions outside of the vertical plane are permitted where protrusions are seven (7) feet or more above grade throughout the gate's range of operation.
 - c. Gate locks, positive stops, and wheels are not considered to be protrusions on sliding gates.
 - 2. Entrapment: Design and install gates and fencing such that there are no entrapment areas. Where entrapment areas are unavoidable due to configuration of the gate, provide entrapment protection devices.
 - a. Provide protection devices compliant with UL 325. Provide non-contact sensors where possible.
 - b. Loop detectors are not entrapment protection devices. Protection devices must be capable to detect presence of human beings in the entrapment area(s).

3. Reach-through Prevention: Openings in the gate shall be designed, guarded or screened from the bottom of the gate to the top of the gate (or to a minimum of 72 inches above grade where indicated in Drawings), to prevent a 2-1/4" sphere from passing through openings anywhere in the gate, and that portion of fencing that the gate covers in the open position.
4. Controls location: Card Readers, keypads, or similar control devices shall be located at least 6' from moving parts of the gate and in such a way that users cannot reach over, under, around, or through the gate to activate a control.
5. Unlevel Gates: Gates shall be designed and installed such that movement will not be initiated by gravity when an automated operator is disconnected. Provide counterbalance mechanisms where required.
6. Fall-over Prevention for Sliding Gates: Design and install gates so that they cannot fall over more than 45 degrees from the vertical plane when detached from the supporting hardware. Provide catcher posts or brackets of adequate strength to resist fall over without bending or deflection of the posts or brackets.
7. Gate Roller Protection: All exposed rollers shall have guards or covers.
8. Positive Stops: Sliding gates shall have positive stops to limit travel to the designed fully open and fully closed positions, and shall project no more than that required to perform their intended function.

1.06 SUBMITTALS

- A. Product Data: Submit manufacturer's technical data and installation instructions for metal fencing, fabric, hardware, operators, and accessories.
- B. Shop Drawings: Provide plan layout, elevations, grid and spacing of components including fittings, hardware, accessories, and anchorages. Show all components of construction in elevations.
 1. For gate and operator. Include elevations, hardware details and installation details.
- C. Informational Submittals:
 1. Certificates: Manufacturer's certificate certifying that Products meet or exceed specified requirements.
 2. Qualifications.

1.07 CLOSEOUT SUBMITTALS FOR GATE OPERATORS

- A. Provide copies of operation of maintenance manuals for gate operators and associated control components. Manual should identify part numbers for future maintenance procurement.
- B. Copies of actuated warranties. Contractor is responsible for submitting completed warranty documentation to manufacturer, and copies for Owner's warranty binder and O&M manuals.

1.08 WARRANTY

- A. Gate Operators: Manufacturer's standard form 5-year warranty against defects in materials in which Manufacturer agrees to provide repair or replacement of defective parts or units without cost to Owner. Warranty excludes labor costs.
 1. Installer's 2-year guarantee to make repairs due to defects in installation, and including all costs to replace parts found to be defective within the warranty period, at no additional cost to Owner.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Dimensions indicate form pipe, roll-formed, and H-sections are outside dimensions, exclusive of coatings. Conform to CLFMI Product Manual.

2.02 MATERIALS

- A. PVC-coated Chain Link Fence: ASTM A 668-2b; 9 ga. (0.148") polyolefin ASTM F668-2b coated galvanized steel wire, 2 inch diamond mesh interwoven wire. Top and bottom selvages knuckled and twist. Fabric, framework and fittings shall be pre-galvanized and extruded/coated polyvinyl chloride coating conforming to ASTM F668, ASTM F1234 and ASTM F626, respectively.
 - 1. Color shall be black.
- B. Line Posts: Provide intermediate posts for supporting frame at 10' O.C. maximum. Minimum sizes per delegated design (where applicable), as indicated in Drawings, or as follows, whichever is greatest:
 - 1. Up to 6' tall fence: 2" diameter (Schedule 40) galvanized steel posts.
 - 2. Over 6' to 10' high fence: 2 1/2" (Schedule 40) galvanized steel posts.
 - 3. Over 10' high fence: 3" (Schedule 40) galvanized steel posts.
- C. End, Corner, and Terminal Posts: Minimum sizes per delegated design (where applicable), as indicated in Drawings, or as follows, whichever is greatest:
 - 1. Up to 6' tall fence: 2-1/2" diameter (Schedule 40) galvanized steel pipe.
 - 2. Over 6' to 10' high fence: 3" diameter (Schedule 40) galvanized steel pipe.
 - 3. Over 10' high fence: 4" diameter (Schedule 40) galvanized steel pipe, .
- D. Gate Posts: Minimum sizes per delegated design (where applicable), as indicated in Drawings, or as follows, whichever is greatest:
 - 1. 3" Galvanized (Schedule 40) for all gates less than 6'-0" in width.
 - 2. 4" Galvanized (Schedule 40) steel pipe for gates 6'-0" and over in width.
 - 3. 6" Galvanized (Schedule 40) steel pipe for swing gate leafs over 6'-0" in width and nominal 8 feet high or taller, and swing gates over 10' in width.
 - 4. Sliding gates of all sizes: 4" Galvanized (Schedule 40) steel pipe.
- E. Fencing Horizontal and Bracing Members:
 - 1. Top Rails: 1.66" outside diameter galvanized pipe with couplings minimum 6" long.
 - 2. Top Wire: 6 Gauge coated coil spring tension wire, metal and finish to match fabric.
 - 3. Intermediate Rails: 1.66" outside diameter galvanized pipe with 6" long expansion type couplings, with means to attach securely to all adjacent posts.
 - 4. Bottom: 6 Gauge coated coil spring tension wire, metal and finish to match fabric.
 - 5. Post Brace Assembly: Manufacturer's standard adjustable brace at all end and gate posts, and at both sides of corner posts, with horizontal brace located at mid-height of fabric. Use same materials as other rails for brace rail, and truss to line posts with 0.375 inch diameter rod and adjustable tightener.

2.03 ACCESSORIES

- A. Post Tops: Provide weathertight closure cap with loop to receive tension wire or top rail as applicable; one cap for each post. Finish to match post.
- B. Stretcher Bars: One-piece lengths equal to full height of fabric, with minimum cross-section of 3/16" x 3/4". Provide one stretcher bar for each gate and end post, and two for each corner and pull post, except where fabric is integrally woven into post.
- C. Stretcher Bar Bands: Manufacturer's standard. Space not over 15" o.c. to secure stretcher bars to end, corner, pull and gate posts.
- D. Gate Truss Rods: 3/8" diameter galvanized steel adjustable length truss rods.
- E. Wire Supporting Arms: Galvanized steel 45 degree, "single-arm" type with provision for anchorage to each post and attaching three rows of barbed wire to each arm and capable of

withstanding 250 lbs. downward pull at each arm. The top wire shall be 12" horizontally from fence line.

- F. Concrete Footings: Provide concrete consisting of Portland cement, ASTM C 150, aggregates, ASTM C 33, and clean water. Mix materials to obtain concrete with a minimum 28-day compressive strength of 2500 psi using at least 4 sacks of cement per cu. yd., 1" maximum size aggregate, maximum 3" slump, and 2% to 4% entrained air.

2.04 GATE FABRICATION

- A. Motorized Sliding Gates and Hardware: Construct motorized gates and provide hardware in compliance with code requirements and referenced standards. For gates less than 10 feet in opening width, construct slide gates of welded galvanized steel pipe as similar to manual slide gates. For gates 10 feet to 30 feet in opening width, provide aluminum framed slide gates. Tymetal, Fortress type gate is basis of design. Gates shall not exceed 30 feet in width.
1. Frame shall be fabricated from 6063-T6 aluminum alloy extrusion. The top member shall be 3 inch x 5 inch aluminum structural channel/tube extrusion weighing not less than 3.9 lbs/lf. The top member shall be "keyed" to interlock with the "keyed" track member. The bottom member shall be a single horizontal aluminum structural tube weighing not less than 2.0 lbs/lf or a spliced 2 inch x 5 inch aluminum structural channel weighing not less than 2.65 lbs/lf. The two horizontal sections may be spliced in the field.
 2. Splicing: A 1/4 inch x 5 inch x 24 inch galvanized steel splice plate shall be used to secure the two 5 inch channel bottom members together utilizing eight 3/8 inch x 1 1/2 inch plated carriage bolts with lock nuts. The top members shall be spliced together on the side opposite the track member using a 1/4 inch x 2 inch x 24 inch aluminum splice plate secured with six 1/4 inch x 1/2 inch drive rivets on one side and welded to the top member on the other side. On the track side, the track is to be overlapped 24 inch onto the opposing section, interlocked with the top member and vertically secured in place using six 1/4 inch x 1/2 inch drive rivets and horizontally secured in place using six 5/16 inch x 1 inch plated hex head cap screws. The respective splice end vertical member shall be 1 inch x 2 inch, weighing not less than 0.82 lbs/lf. The 1 inch x 2 inch members will be joined utilizing 5/16 inch x 2 3/4 inch plated hex head cap screws, quantity varying by height of gate.
 3. The vertical members shall alternate between 2 inch x 2 inch and 1 inch x 2 inch in cross section weighing not less 1.1 lbs/lf and 0.82 lbs/lf respectively. The spacing for the vertical intermediates shall be no greater than half the height of the gate.
 4. The gate frame shall have a separate semi-enclosed "keyed" track, extruded from 6105-T5 aluminum alloy, weighing not less than 2.9 lbs/lf. Track member to be located on only one side of the top member. When interlocked with the "keyed" top member and welded to it, it forms a composite structure with the top of the gate frame. Welds to be placed alternately along the top and side of the track at 9 inch centers and a minimum of 2 inches long.
 5. The gate frame is to be supported from the track by two swivel type, self aligning, 4-wheeled, sealed lubricant, ball-bearing truck assemblies. The bottom of the support posts shall be equipped with two pairs of 3 inch rubber guide wheels.
 6. Diagonal "X" bracing of 3/16 inch minimum diameter stainless steel aircraft cable shall be installed to brace the gate panels and to provide a ready means of vertical alignment.
 7. Provide gate with drive rail angle through bolted to gate frame verticals. Coordinate size, elevation, mounting, and other requirements of the drive rail with gate operator manufacturer's requirements and recommendations.
 8. Provide manufacturer's standard heavy duty track, ball-bearing hanger sheaves, overhead framing and supports, guides, stays, bracing, and accessories as required for complete installation.

B. Manually Operated Swing Gates:

1. Fabricate perimeter frames of minimum 1.90" o.d. galvanized steel pipe. Provide intermediate horizontal and vertical members to ensure proper gate operation and attachment for fabric, hardware, and accessories. Space intermediate members not more than 8 feet on center, unless more stringent requirements are otherwise indicated.
2. Assemble gate frames by welding or with special fittings and rivets for rigid connections, providing security against removal or breakage connections, providing security against removal or breakage connections.
3. Provide same fabric as for fence, unless otherwise indicated. Install fabric with stretcher bars at vertical edges and at top and bottom edges. Attach stretcher bars to gate frame at not more than 15" o.c.
4. Install diagonal cross-bracing consisting of 3/8" diameter adjustable length truss rods on gates to ensure frame rigidity without sag or twist.

C. Swing Gate Hardware:

1. Hinges shall be of size and material to suit gate size, non-lift-off type, offset to permit 180 degree gate opening. Provide 1-1/2 pair of hinges for each leaf over 6' nominal height, 2 pair for each leaf for gates over 8' nominal height.
2. Latch shall be forked type or plunger-bar type to permit operation from either side of gate, with padlock eye as integral part of latch.
3. Provide gate keepers except for gates that do not swing past edge of paving] [unless specifically indicate, which automatically engages gate leaf and holds it in open position until manually released. Keepers shall be of type that provide vertical load support the end of the gate in open position.

2.05 FINISHES

- A. At fencing indicated to be PVC coated, all fence posts, fabric, components and accessories shall be galvanzied with matching color PVC coating unless otherwise indicated.

2.06 SLIDE GATE OPERATORS

- A. Gate operators must conform to UL325, Standards for Safety. The operator must be tested by an independent testing laboratory such as UL or ETL and found to conform to these standards. The completed installation shall conform to applicable ASTM and UL requirements.
- B. Basis of Design Unit: HySecurity Slide Driver Unit, sized to opening and weight of gate.
- C. All electrical work is to be done by qualified electricians and is to conform to all applicable local, state, and federal codes.
- D. General Operation
1. The operator must be designed for high speed, high-cycle applications and low maintenance. The operator shall be capable of actuating gates up to 30 feet in overall length. The gate operator must be able to operate gates up to 150 per cent of weight of actual gate at 2.2 feet per second.
 2. All fasteners, except structural bolts, are to be stainless steel, or other non-corrosive material.
 3. The operator is to provide wear compensating, spring-loaded, friction-feed type drive mechanism. The drive mechanism is to consist of two drive wheels that can be manually disconnected by a toggle style disconnect. This disconnect is to instantly disengage the drive wheels for manual operation. The operator, upon returning to automatic operation by engaging the drive mechanism, shall function properly without regard to the gate's actual position.

E. Housing Construction

1. The housing cover must swing open to allow access to the internal components.
 2. The housing cover must be lockable.
 3. All operator cover locks are to be keyed alike.
 4. The housing, chassis and cover to be galvanized for corrosion resistance per ASTM 123 M.
- F. Electric Motor
1. The electric motor used in the gate operators must have a continuous-duty rating of two horsepower with a service factor of 1.15 or greater and shall be available in all voltages and phases to suit the installation requirements of the site.
 2. The electric motors must have built-in overload protection and resettable with a sealed pushbutton reset.
- G. Hydraulic System
1. The hydraulic system must be self-contained and contain pump, reservoir, two position control valve, hydraulic hoses, fittings and hydraulic motors.
 2. All hydraulic hoses shall have a minimum burst pressure of 12,000 pounds per square inches.
 3. The hydraulic motors must be automatically locked when the control valve is in the de-energized to prevent slippage of the drive wheels.
 4. The hydraulic system must be soft-start and soft-stop to minimize shock loads transmitted to the gate system including a reverse delay to maximize gate hardware life.
- H. Electrical
1. Built in “warn before operate” system.
 2. 26 programmable user relay output options.
 3. Built-in power surge / lightning strike protection.
 4. Control circuit: 24VDC.
 5. Electrical enclosure: Oversized, metal, with hinged lid gasketed for protection from intrusion of foreign objects, and providing ample space for the addition of accessories.
 6. Menu configuration, event logging and system diagnostics easily accessible with integral touchpad or a PC and free START software.
 7. Limit switch shall feature a built in LED “tripped” indicator light. The limit switch must readily accessible, adjustable and replaceable with normal hand tools.
 8. The limit switches are to provide the ability to remote monitor the gate position when in the fully closed and fully open positions.
- I. Accessories
1. Through beam type photo detectors, and contact sensor at leading edge of gate.
 2. Fire Department Operation: Provide with fire department key switch operation box.
 - a. Mounting: Provide and mount on free standing stanchion.
 3. Signage: Provide motorized gate safety advisory signage compliant with code requirements, with attachment hardware as required, to mount at each side of motorized gates.
- J. Inductive vehicle loop detectors
1. Inside and outside obstruction loops are to be installed to prevent the gate from closing when vehicle traffic is present.
 2. Free exit loops are to be installed for exit lane gates.
 3. Loops for gates with heavy truck traffic will have no side of the loop less than 6’.
 4. Loop wire to be stranded Thhn or XLPE, crosslink poly-ethylene jacketed type acceptable for direct burial.
 5. Refer to detail drawings for specific loop placement or refer to manufacturers recommendations.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Verify grading adjacent to fence locations, and other requirements for installation, are complete. Coordinate power location and requirements for gate hardware with electrical contractor. Coordinate requirements for gate hardware installed by other trades with hardware installer.
- B. Lay out fence according to construction Drawings.
- C. Gate Operator: Coordinate conduit runs and electrical connections with the work of Electrical and Access Control work by other trades, including with access control by separate contract where applicable.
- D. Verification of Conditions: Verify that field measurements, surfaces, substrates and conditions are as required, and ready to receive Work. Report in writing prevailing conditions that will adversely affect satisfactory execution of the Work of this Section. Do not proceed with Work until unsatisfactory conditions have been corrected. By beginning Work, Contractor accepts conditions and assumes responsibility for correcting unsuitable conditions encountered at no additional cost to the Owner.

3.02 INSTALLATION

- A. General:
 - 1. Install fence in accordance with ASTM F 567 and manufacturer's published instructions.
 - 2. Install gates in accordance with ASTM F 900, ASTM F2200 or ASTM 1184 as applicable and to manufacturer's published instructions.
- B. Space line posts 8 feet on center maximum unless otherwise indicated in Drawings. Space line posts at equal distances in each run between corner posts, terminal posts, and gate posts unless otherwise indicated.
- C. Excavation: Drill or hand excavate holes for posts to 36" deep and 10" diameter, or not less than four times the post diameter, whichever is greater; for gate and corner posts 16" dia. x 40" deep. Set bottom of posts a minimum of 36" inches below grade. Hold post in position while placing, consolidating, and finishing concrete.
 - 1. Provide minimum 48" concrete post embedment where 6" diameter swing gate posts are required.
 - 2. Provide greater size footings and post embedment depth where required by other design criteria.
 - 3. Coordinate post footings with concrete mow strips where indicated in Drawings.
- D. Brace Assemblies: Install braces so posts are plumb when diagonal rod is under proper tension.
- E. Tension Wire: Install tension wires through post cap loops before stretching fabric and tie to each post cap with not less than 6 ga. galvanized wire. Fasten fabric to tension wire using 11 ga. galvanized steel hog rings spaced 24" o.c.
- F. Fabric: Pull fabric taut and tie to posts, rails and tension wires. Install fabric on service area side of fence, and anchor to framework at 15" o.c. max. so that fabric remains in tension after pulling force is released. Position bottom within 1-1/2" maximum above finished grade from bottom of selvage to grade.
- G. Stretcher Bars: Thread through or clamp to fabric 4" o.c., and secure to posts with metal bands spaced 15" o.c.
- H. Tie Wires: Use U-shaped wire, conforming to diameter of pipe to which attached, clasp pipe and fabric firmly with ends twisted at least two full turns. Bend ends of wire to

minimize hazard to persons or clothing. Tie fabric to line posts, with wire ties spaced 12" o.c.. Tie fabric to rails and braces with wire ties spaced 24" o.c.. Tie fabric to tension wires with hog rings spaced 24" o.c.

- I. Fasteners: Install nuts for tension bands and hardware bolts on side of fence opposite fabric side. Peen ends of bolts or score threads to prevent removal of nuts.
- J. Gates: Install gates plumb, level and secure for full opening without interference. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary.
- K. Construction Tolerances:
 - 1. Maximum Variation from Plumb: 1/4 inch.
 - 2. Maximum Offset from True Position: 1 inch.
 - 3. Locate fencing components completely within site boundaries. Do not infringe adjacent property lines.
 - 4. Maximum Fence Distance from Ground: 1 1/2 inches.
 - 5. Maximum Gate Clearance from bottom rail to Grade or Paving: 4 inches.

3.03 FIELD QUALITY CONTROL FOR GATE OPERATORS

- A. Test gate operator through at least ten full cycles and adjust for operation without binding, scraping or uneven motion.
- B. Test all safety devices and detectors for proper operation. Test limit switches for proper "at rest" gate position. Test all controls for proper operation, including key switch operation controls, where applicable.
 - 1. Test operation of access controls system installed by other trade, jointly with access controls installer, as required to resolve any faulty operation.
- C. All anchor bolts shall be fully concealed in the finished installation.
- D. Coordinate, schedule and provide gate operator Manufacturer's site observations and complete Manufacturer's punch list items prior to final acceptance of the installation and submission of completed warranty documentation, as applicable to Manufacturer's warranty requirements.

3.04 CLEANING AND ADJUSTING

- A. Verify all operable parts are properly lubricated and functioning. Check all mechanical connections for tightness and alignment.
- B. Prior to substantial completion, clean the fence as recommended by manufacturer.
- C. Remove post-hole excavation material, or if material is not detrimental to landscaping then scatter uniformly to grade prior to landscaping installation.
- D. Remove excess jobsite materials.

3.05 DEMONSTRATION AND TRAINING

- A. Demonstrate operation and train Owner's personnel in operation and maintenance of motorized gate systems to comply with Division 01 "Demonstration and Training".

END OF SECTION 32 31 12

SECTION 32 31 30 - PRECAST CONCRETE FENCE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Precast concrete fence installation, as shown on the drawings, and as herein specified.
- B. Related Sections include the following:
 - 1. Division 3 Section: Cast-in-Place Concrete
 - 2. Division 9 Section: Painting

1.03 SUBMITTALS

- A. Product Data: Submit manufacturer's technical data, and installation instructions for concrete fencing, fabric and accessories.
- B. Shop Drawings: Provide system details, plan layout and spacing of components including posts and panels.

1.04 QUALITY ASSURANCE

- A. Provide concrete fencing as manufactured by a single fabricator, including necessary accessories.
- B. Installation by company specializing in commercial/institutional quality fencing with five years experience.

1.05 ENGINEERING DESIGN

- A. Design fencing to fit dimensions and loads required by use. Design in accord with values assigned by most restrictive industry guidelines.

PART 2 - PRODUCTS

2.01 GENERAL

- A. All construction to conform to local building department codes.
- B. All reinforcing steel shall conform to ASTM A615, Grade 40.
- C. All foundations are to be located in undisturbed soil or compacted fill. Lateral bearing pressure shall equal 300 psf.
- D. Fence wall designed for a load of 15 lbs per sq. ft.
- E. Approval of the engineer is required when the wall is to be used under a condition where the specifications are different.
- F. The contractor shall verify all conditions at the job site prior to beginning the work.

2.02 MATERIALS

- A. Precast Concrete Fence: Fence shall be of style, color and dimensions to match existing simulated brick and mortar appearance. Fence shall be Fencecrete America, INC. (210) 492-7911, "Rock Style Concrete Fence"

1. Posts: 5" x 7" concrete posts for supporting panels at 5' O.C. maximum.
 2. Concrete Panels: 4'-9" L x 1'-0" W x 1-3/4" Thick with 6" x 6" WWF reinforcing.
 3. Concrete Cap: 4'-9" L x 4" W x 3" H reinforced concrete cap.
 4. Footings: 18" diameter x 5' d.concrete pier into undisturbed soil at each post with 2 #6 bars each side.
- B. Concrete: Provide concrete consisting of Portland cement, ASTM C 150, aggregates, ASTM C 33, and clean water. Mix materials to obtain concrete with a minimum 28-day compressive strength of 2500 psi using at least 4 sacks of cement per cu. yd., 1" maximum size aggregate, maximum 3" slump, and 2% to 4% entrained air.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Excavation: Drill or hand excavate holes for posts to 12" diameter x 60" deep.
- B. Bracing: Install braces so posts are plumb when concrete is curing.
- C. Concrete panels and cap installed and secured between concrete posts plumb and level.

END OF SECTION 32 31 30

SECTION 32 84 00 - PLANTING IRRIGATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Furnish all labor, material, equipment, and services necessary to provide all landscape planting irrigation, complete in place, as shown and specified.
 - 1. Installation of permanent automatic irrigation system.
 - 2. Installation and removal of temporary irrigation system where required for establishment of plantings and turf.
- B. Related Work Specified in other Sections:
 - 1. Division 22 Section - Plumbing
 - 2. Division 26 Section - Electrical for power for controller(s)
 - 3. Division 28 for data connection to remotely monitored controller(s)
 - 4. Division 32 Section - Paving for coordination of irrigation sleeves
 - 5. Division 32 Section - Unit Pavers for coordination of irrigation sleeves
 - 6. Division 32 Section - Landscaping
 - 7. Division 32 Section - Turf and Grasses
 - 8. Division 33 Section - Utilities for requirements for irrigation taps

1.03 SUBMITTALS

- A. Product Data: For all materials and components of irrigation system.
- B. Shop drawings for irrigation system shall be designed by a qualified irrigation engineer according to the specified criteria, registered as required for the project location, and submitted to Architect for approval prior to submitting for regulatory approval or permitting. Where sleeves under new paving are part of the scope of work, irrigation shop drawings shall be submitted in time for Architect's review, prior to start of paving work. All irrigation plans shall contain the following information:
 - 1. The irrigator's seal, signature, and date of signing.
 - 2. All major physical features and the boundaries of the areas to be watered.
 - 3. A North arrow
 - 4. A legend
 - 5. The scale used
 - 6. The design pressure
 - 7. The zone flow measurement for each zone
 - 8. Location and type of each controller
 - 9. Location, type, and size of each:
 - a. Water source, such as, but not limited to a water meter and point(s) of connection
 - b. Backflow prevention device
 - c. Water emission device, including, but not limited to spray heads, rotary sprinkler heads, quick-couplers, bubblers, drip, or micro-sprays
 - d. Valve, including but not limited to, zone valves, master valves, and isolation valves
 - e. Pressure regulation component
 - f. Main line and lateral piping
 - g. Sleeving

1.04 CLOSEOUT SUBMITTALS

A. Record and As-built Drawings:

1. The Contractor shall provide and keep up to date, a complete "as-built" record set of prints which shall be corrected daily and show changes from original drawings and specifications. Record and continuously update exact "as-built" locations, sizes, and kinds of equipment as irrigation system is installed. This set of drawings shall be kept on-site and be used only as a record set.
2. These drawings shall be kept readily available for inspection at any time.
3. The Contractor shall make neat and legible notations on as-built sheets as the work proceeds, to reflect components as actually installed.
4. Before final completion, Contractor shall transfer all information from "as-built" prints to a copy of the approved shop drawing submittal. Contractor shall use symbols and notation consistent with original shop drawings.
 - a. Where as-built copy is neatly recorded and maintained in excellent physical condition, Architect, at their discretion, may allow the as-built copy to become the record set.
5. The Contractor shall dimension from two (2) permanent points of reference (building corners, sidewalk, or road intersections, etc.), the location of the following items:
 - a. Connection to existing water lines
 - b. Connection to existing electrical power
 - c. Gate valves
 - d. Routing of sprinkler pressure lines (locate start and end points and with dimensions at maximum intervals of 100' along routing)
 - e. Irrigation control valves
 - f. Routing of control wiring
 - g. All other boxes, and other related equipment as directed by Architect

B. Operation and Maintenance data.

1. Index sheet stating Contractor's address and telephone number, list of equipment with name and addresses of local Manufacturer representatives.
2. Catalog and parts sheets on every material and equipment installed under this contract.
3. Complete operating and maintenance instructions on all major equipment.
4. Guarantee statement.
 - a. "This irrigation system has been installed in accordance with all applicable state and local laws, ordinances, rules, regulations or orders. I have tested the system and determined that it has been installed according to the Irrigation Plan and is properly adjusted for the most efficient application of water at this time."

C. Controller Schedules: (2) copies of laminated controller schedules, sized as appropriate to controller and number of zones. Charts to state zone number with brief description of the location, and installer's recommended watering duration and frequency per week for each zone after landscape plantings are established. (Example: Zone 1: South lawn - 20 min. - twice per week). Post one copy at controller and include second backup copy with O&M's.

D. Controller Zone Maps: (2) copies of laminated 8-1/2"x11" or 11"x17" zone maps (sized as appropriate to scale of irrigated site area) showing coverage boundaries of each zone and their associated valves. One copy to be posted at irrigation controller and a second copy provided to Owner with O&M's as backup copy. Zone maps shall either be color coded or with boxes neatly drawn around the heads of each zone, and clearly numbered to correspond to each zone matching the zones on the irrigation controller.

1.05 DELEGATED DESIGN

- A. Engage a licensed irrigation engineer to design and permit a complete irrigation system in compliance with these specifications and the requirements of authorities having jurisdiction. System design must be approved by Architect prior to permitting, and by Authorities having jurisdiction before installation.
- 1. Contractor shall design an automatic irrigation system to provide sufficient irrigation to maintain all plantings shown in the Landscaping plans. System design must include a zone coverage map showing complete coverage of all landscape bed areas, and head-to-head coverage for all turf irrigation.
 - a. Landscape beds shall be solely comprised of drip and bubbler irrigation. Where possible, micro irrigation may be utilized.
 - b. All new trees shall receive bubbler irrigation even if located within the coverage area of another zone in the Landscape Drawings.
 - c. No different types of irrigation emitters (e.g. drip, spray, rotor, or bubbler) shall be installed on the same zone.
 - d. Irrigation design must account for minimum drift and reduction of water on street and paved surfaces.
 - e. Install heads minimum 4 inches from any hard surface.
 - f. All heads and valves shall be from the same manufacturer.
 - g. Provide swing joints (6 inch minimum length) for all pop up spray heads and turf type rotor heads.
 - h. All valves shall be in plastic valve boxes no smaller than 10" for single control valves, or nominal 12" x 17" for other valves. Box shall be adequately sized to provide service access for all valves in all cases.
 - i. Thrust blocks and concrete valve boxes may be required by Authorities having jurisdiction. Contractor shall coordinate.
 - j. Lateral lines to have a minimum 12 inches coverage. Main lines to have minimum 18 inches coverage.
 - k. Make adjustments in the field as necessary to avoid plantings and other obstructions.
- 2. The irrigation system shall strictly adhere to all TCEQ rules and regulations and be designed to operate within performance and design requirements using available pressure without supplementary pump.
 - a. Design pressure and static pressure shall be indicated on irrigation plans.
 - 1) The irrigation engineer is responsible for determining existing water pressure.
 - b. Irrigation plan to show velocities for all piping.
 - 1) Velocities shall not exceed 5 F.P.S.
 - c. System shall be capable of applying 0.33 inches of water during a single watering cycle, between 6:00 pm - 10:00 am.
 - 1) All zones must operate during one watering cycle.
- 3. Installation of required sleeves shall be coordinated with other trades prior to paving work, as required.
 - a. All utilities under hard (paved) surfaces shall be sleeved.
 - b. Where existing paving to remain is in the path of irrigation lines, include boring as required to install new irrigation system, unless otherwise noted in Drawings.
 - c. Sleeves shall be large enough for wire and pipe as required and extend 12 inches beyond hard surface.

1.06 QUALITY ASSURANCE

- A. Installer and Designer Qualifications: Licensed and approved as required by local authorities having jurisdiction. Installer with minimum 5 years continuous operation installing irrigation systems of comparable scale and complexity, under the current company and name.
- B. Ordinances, Codes and Regulations: All local, municipal, and state laws, rules and regulations governing any portion of this work are hereby incorporated into and made a part

of these specifications. Their provisions shall be carried out by the Contractor. Requirements of these specifications shall not be construed to conflict with any of these rules, regulations, or requirements of the same.

1. When these specifications and drawings require materials, workmanship, or construction of a better quality, higher standard, or larger size than is required by the above rules and regulations, these specifications and drawings shall take precedence
- C. Permits and Fees: The Contractor shall obtain and pay for any permits and observations as required by authorities having jurisdiction.
- D. 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.
- E. Manufacturer's Directions: Manufacturer's directions and detailed drawings shall be followed in all cases where the manufacturers of articles used in this contract furnish directions covering points not shown in the drawings and specifications.

1.07 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Handling of PVC Pipe and Fittings: The Contractor is cautioned to exercise care in handling, loading, unloading, and storing of PVC pipe and fittings. Pipe that has been damaged will be discarded. Installed pipe found to be damaged shall be replaced with new piping. Store plastic piping protected from direct sunlight.

1.08 SUBSTITUTIONS

- A. Equipment or material substitutions other than those listed on the drawings or specifications must include the following information for review:
 1. Provide a statement indicating the reason for making the substitution. Use a separate sheet of paper for each item to be substituted.
 2. Provide descriptive catalog literature, performance charts and flow charts for each item to be substituted.
 3. Provide the amount of cost savings if the substituted item is approved.
- B. Architect shall have sole authority in accepting or rejecting substituted items as approved equal.

1.09 GUARANTEE

- A. Provide Guarantee for the irrigation system in accordance with the attached form. The Standard Form of Agreement and General Conditions of these specifications shall be filed with Owner or his representative, prior to acceptance of the irrigation system.
- B. A copy of the Guarantee form shall be included in the operations and maintenance manual.
- C. The Guarantee form shall include the Contractor's letterhead, and contain the following information:

GUARANTEE FOR AUTOMATIC IRRIGATION SYSTEM

We hereby Guarantee that the automatic irrigation system we have furnished and installed is free from defects in materials and workmanship, and the work has been completed in accordance with the drawings and specifications. We agree to repair or replace any defects in material or workmanship which may develop during the period of One Year from date of acceptance, and to also repair or replace any damage resulting from such warranty work at no additional cost to the Owner. We shall make such repairs or replacements within a reasonable time, as determined by the Owner, after receipt of written notice from the Owner. If we are unable to make such repairs and/or replacements within the given time frame, we authorize the Owner to proceed with repairs / replacements, to be made at our expense. We shall pay the costs and charges

upon demand.

PROJECT: _____

LOCATION: _____

SIGNED: _____

ADDRESS: _____

PHONE: _____

DATE OF ACCEPTANCE: _____

1.10 EXTRA MATERIALS

- A. Supply as a part of this contract the following:
 - 1. Controller Schedule
 - 2. Controller Zone Map
 - 3. Two (2) keys for each automatic controller.
- B. Extra materials shall be turned over to Owner at conclusion of the project.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Provide materials from manufacturers as specified herein, or approved equal:
 - 1. Heads, Valves, Drip Irrigation Components, Quick Couplers, Sensors & Controllers
 - a. Hunter
 - b. Toro
 - c. Rain Bird

2.02 MATERIALS

- 1. Water Meter: As required to operate system, and as approved by authorities having jurisdiction: 2 inches.
- 2. Greater than 2 inches: Provide (two) 2-inch meters in tandem.
- B. Isolation Valve
 - 1. Ball Valve: As required to operate system, and as approved by authorities having jurisdiction.
 - 2. Square Nut Gate Valve: As required to operate system, and as approved by authorities having jurisdiction.
- C. Anti-Siphon Device:
 - 1. Reduced Pressure Zone Assembly
- D. Piping and Fittings:
 - 1. PVC Pressure Main Lines:
 - a. Pipe shall be made from an NSF approved Type I, Grade II, PVC compound conforming to ASTM resin specification D2672. All piping must meet requirements as set forth in Federal Specification PS-22-70, with an appropriate standard dimension ratio (S.D.R.) (Solvent-weld Pipe).
 - 1) Pressure main line piping less than 2" in outside diameter shall be Schedule 40 PVC with solvent welded joints.
 - 2) Pressure main line piping 2" in outside diameter and greater shall be class 315 PVC with solvent welded joints.
 - 2. PVC Non-Pressure Lateral Line Piping:
 - a. Pipe shall be made from NSF approved Type I, Grade II PVC compound conforming to ASTM resin specification D2672. All piping must meet requirements as set forth in Federal Specification PS-22-70, with an appropriate standard dimension ratio (S.D.R.).

- 1) Non-pressure buried lateral line piping shall be PVC class 200 with solvent-weld joints.
 3. All solvent weld PVC fittings shall be standard weight Schedule 40 (and Schedule 80 where specified on the irrigation detail sheet, all mainline fittings shall be Schedule 80 PVC) and shall be injection molded of an improved virgin PVC fitting compound. Slip PVC fittings shall be the "deep socket" bracketed type. Threaded plastic fittings shall be injection molded. All tees and ells shall be side gated. All fittings shall conform to ASTM D2464 and ASTM D2466.
 4. All solvent cementing of plastic pipe and fittings shall be a two-step process, using primer and solvent cement applied per the manufacturer's recommendations. Cement shall be of a fluid consistency, not gel-like or ropy. Solvent cementing shall be in conformance with ASTM D2564 and ASTM D2855.
 5. All PVC pipe must bear the following markings:
 - a. Manufacturer's name.
 - b. Nominal pipe size.
 - c. Schedule or class.
 - d. Pressure rating in P.S.I.
 - e. NSF (National Sanitation Foundation) approval.
 - f. Date of expiration.
 6. When connection is plastic to metal, female adapters shall be hand tightened, plus one turn with a strap wrench. Joint compound shall be non-lead base Teflon paste, tape, or equal.
 7. All pressure main lines installed with solvent weld PVC fittings shall be installed with concrete thrust blocking at all directional changes in the mainline routing. Concrete thrust blocking shall not be required when ductile iron fittings and mechanical restraints are specified.
 8. All fittings shall bear the manufacturer's name or trademark, material designation, applicable I.P.S., schedule number and NSF seal of approval.
- E. Brass and Copper Pipe and Fittings:
1. Where indicated on the drawings, brass pipe shall be 85 percent red brass, ANSI, IPS Standard 125 pounds, Schedule 40 screwed pipe.
 2. Fittings shall be medium brass, screwed 125-pound class.
 3. Copper pipe and fittings shall be Type "K" sweat soldered or brazed as indicated on the irrigation drawings.
- F. Sleeves:
1. Sleeves shall be schedule 40. Provide twice the diameter of pipe it is serving.
 2. Minimum size sleeve for pipe or wire is 2 inch.
 3. Provide spare sleeve at each sleeve location for future use.
 4. Each pipe and wire bundle shall have separate sleeves.
- G. Control Valves:
1. Description: Plastic or metal body, normally closed, diaphragm type with manual-flow adjustment.
 2. All valves shall include a PVC ball valve for isolation. Provide gravel at 4" depth with 1" air gap between gravel and valve.
 3. Install pressure regulating valves for drip system as required. Increase size of valve box as required for access or install PRV's in separate box from control valves.
- H. Wiring: UL 493, Type UF multiconductor, with solid-copper conductors; insulated cable; suitable for direct burial.
1. Feeder-Circuit Cables: No. 12 AWG minimum, between building and controllers.

2. Low-Voltage, Branch-Circuit Cables: No. 14 AWG minimum, between controllers and automatic control valves; color-coded different from feeder-circuit-cable jacket color; with jackets of different colors for multiple-cable installation in same trench.
 3. All splices shall be in valve boxes with grease wire nuts.
 4. Common wire shall be coded white. All other wires to be coded separately.
 5. Wire shall be laid loosely in trench without stretching or stress on wiring. Wiring bundled and taped every 10' at the side of pipe in the trench.
 6. Minimize field splices to extent possible. Where unavoidable, install field splices inside 6" (minimum size) valve box.
 7. Six spare wires shall be run from controller to farthest valves at either end of system, for future expansion. Provide controller with at least this many spare zones.
- I. Miscellaneous Piping Specialties:
1. Water Hammer Arresters: ASSE 1010 or PDI WH 201, with bellows or piston-type pressurized cushioning chamber and in sizes complying with PDI WH 201.
 2. Pressure Gauges: ASME B40.1. Include dial gauge, with dial range of two times system operating pressure, and bottom outlet.
- J. Plastic Boxes: Box and cover, with open bottom and openings for piping; designed for installing flush with grade.
1. Valve boxes shall be fabricated from a durable, weather-resistant plastic material resistant to sunlight and chemical action of soils.
 2. Shape and size: As required for valves and service, and minimum sizes as follows:
 - a. Drip flush valve and Air relief valve: 6" circular.
 - b. Quick coupler valve boxes: 10" circular.
 3. The cover and box shall be capable of sustaining a load of 1,500 pounds.
 4. Valve box extensions shall be by the same manufacturer as the valve box.
 5. The plastic irrigation valve box cover shall be an overlapping type.

2.03 DRIP IRRIGATION SPECIALTIES

- A. General:
1. All bubblers shall be of the same size, type, and deliver the same pressure, and discharge as shown on the approved shop drawings and/or specified in these special provisions.
 2. All bubblers of the same type shall be products of the same Manufacturer.
- B. Drip Tubing and Emitter System:
1. Provide pressure regulating filters after zone valves as required to regulate pressure in polyethylene tubing within manufacturer's recommended pressure range and for design flow rate.
 2. Tubing shall be brown in color.
 3. System should include emitters of various types as recommended by irrigation engineer for optimal performance and approved by Architect in approved shop drawings.
 4. Drip tubing shall be low-density linear polyethylene tubing with:
 - a. Pressure compensating, continuously self-cleaning, integral emitters with internal check valves at a specified spacing **OR**
 - b. Pressure compensating emitters installed externally
 5. Individual pressure compensating emitters shall be welded to the inside wall of the tubing as an integral part of the tubing assembly and shall have a built-in physical root barrier whereby the water shall exit the dripper from one location and shall exit the tubing from a second location.
 6. Drip tubing shall be the size and type specified on the approved shop drawings.
 7. Air/vacuum relief valves and flush valves shall be by the same manufacturer as the drip tubing.
 - a. Air Relief Valves: Brass or plastic housing, with corrosion-resistant internal parts.

- b. Vacuum Relief Valves: Brass or plastic housing, with corrosion-resistant internal parts.
- C. Off-Ground Supports: Plastic stakes.
- D. Application Pressure Regulators: Brass or plastic housing, NPS 3/4, with corrosion-resistant internal parts; capable of controlling outlet pressure to approximately 20 psig.
- E. Filter Units: Brass or plastic housing, with corrosion-resistant internal parts; of size and capacity required for devices downstream from unit.

2.04 AUTOMATIC CONTROL SYSTEM:

- A. General: Furnish low voltage system for control of automatic circuit valves for underground sprinkler systems. Provide capacity to suit number of circuits as required for system as described.
- B. Transformer: Provide as required to reduce building service voltage to control voltage of 24 volts.
- C. Circuit Control: Each circuit variable from approximately 5 to 60 minutes. Include switch for manual or automatic operation of each circuit.
- D. Controller: Adjustable, 24-hour, (7 or 14 day) clocks, capable to run a program once or two or more times during a day, and to run or skip operation for any day in either 7 or 14 day recurring periods. Controller to allow to program and store a minimum of two recurring programs. Each zone individually programmable for each watering program, from 1 to 60 minutes, by 1 minute increments. Allow for manual or semi-automatic operation without disturbing preset automatic operation.
 - 1. Controller capable of being remotely monitored and programmed/controlled through data connection.
 - 2. Model: Any model meeting specified requirements.
 - 3. Exterior Control Enclosure: NEMA 250, Type 4, weatherproof, with locking cover and two matching keys; include provision for grounding.
 - a. Body Material: Molded plastic
 - b. Mounting: Surface type for mounting to wall
 - 4. Interior Control Enclosures: NEMA 250, Type 12, drip-proof, with locking cover and two matching keys.
 - a. Body Material: Molded plastic
 - b. Mounting: Surface type for mounting to wall.
- E. Provide rain/freeze and moisture sensors. Locate at back side of parapet and with wiring penetrations and attachment of sensor per roofing contractor's requirements, or in another location acceptable to Architect and where protected from vandalism.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Site Conditions:
 - 1. All scaled dimensions are approximate. The Contractor shall verify all site dimensions.
 - 2. Exercise care in excavating and working near existing utilities. Contractor shall be responsible for damage to utilities caused by his operations. Review drawings for existing utility locations, and when required, have utilities located when not shown.
 - 3. Irrigation system shall not interfere with now or existing utilities, or other construction. System shall not cause difficulty in planting trees, shrubs, and ground covers. Coordinate work of all sub-contractors.
 - 4. Verify all grades for conflicts before starting work on the irrigation system.

- B. Notify Architect in writing of conditions detrimental to timely completion of work.
- C. Do not proceed until conditions are satisfactory.

3.02 COORDINATION AND PREPARATION

- A. Coordinate work embedded in concrete/masonry or routed under paved areas. Provide sleeves as required.
- B. Locate and mark all existing utilities that may conflict with trenching.
- C. Set stakes to identify location of irrigation system heads.
- D. Provide timely delivery and installation at job site.

3.03 INSTALLATION

- A. General:
 - 1. Excavation: Excavate earth, rock or any combination thereof, in wet or dry state.
 - 2. Backfill: Use excavated material except where pipe manufacturer's specifications require otherwise. Use select fill dirt or sand if existing soil is rocky or contains large clods. Hand-tamp and water-jet to prevent settling. Hand rake trenches and adjoining areas to leave grade in as good or better condition prior to beginning installation.
 - 3. Pipe Layout: Route around trees and shrubs to avoid damage to root system. Do not dig within root balls of newly planted trees or shrubs. Do not move or damage trees and shrubs.
- B. Pipe Installation:
 - 1. Sprinkler Main Lines: Provide 4" wide (minimum) trench, minimum 18" depth. Record locations on record drawings.
 - 2. Lateral Piping: Provide 4" wide (minimum) trench, minimum 12" depth.
 - 3. Trenching: Remove all foreign material and earth greater than 1-1/2" in diameter from trenches. Provide firm, uniform bearing for entire length of pipe to prevent uneven settlement. Pad trenches with dirt or sand where rocky. Do not wedge or block pipe. Lay pipe from side to side of trench bottom to allow for expansion and contraction. Remove foreign matter or dirt from pipe interior prior to welding. Keep clean during / after installation.
 - a. No machine trenching is to be done within drip line of trees. Trenching around existing trees shall be done by hand, by tunneling or boring, or by other methods as approved by Architect. Piping layout is diagrammatic and shall be routed around existing trees to avoid root damage.
 - 4. Install dielectric fittings for dissimilar-metal pipe connections.
- C. PVC Pipe and Fitting Assembly:
 - 1. Solvent: Use type and procedures recommended by pipe manufacturer to make solvent-welded joints. Remove burrs from cut pipe ends and thoroughly clean pipe and fitting of dirt, dust, and moisture before applying primer and solvent.
 - 2. PVC to Metal Connection: Install metal connection first. Use non-hardening pipe dope, such as Permatex No. 2, on threaded PVC to metal joints. Use only light wrench pressure.
 - 3. Threaded PVC Connection: Where required, use threaded PVC adapters to which pipe may be welded. Apply appropriate tape or thread compound to outside threads.
- D. Copper Tubing and Fitting Assembly:
 - 1. Clean pipe and fitting thoroughly. Buff connection with sandpaper to remove pipe residue.
 - 2. Flux pipe and fitting. Solder connection using 50-50 soft solid core solder.
- E. Install sprinklers after hydrostatic test is completed.

- F. Bubblers:
 - 1. Install bubblers as designated on the approved design drawings. Make appropriate adjustments in bubbler layout to accommodate for actual field conditions.
 - 2. Outlet of bubblers shall be located inside the planting saucer for each plant.
- G. Drip Tubing and Emitters:
 - 1. Install pressure regulating valves after zone valves as required to regulate pressure within recommended range for the polyethylene tubing.
 - 2. Install tubing and emitters as indicated on the approved design drawings.
 - 3. Use fittings of the size and type recommended by the manufacturer.
 - 4. Install 6-inch metal wire staples 3 to 5 feet on center, with two staples installed over every change-of-direction fitting.
 - 5. Spacing of heads/emitters and inline drip tubing shall not exceed maximum indicated on the approved design drawings, or manufacturer's recommendations, whichever is less.
- H. Electric Remote Control Valve:
 - 1. Supply in accordance with equipment list. Size according to approved drawings.
 - 2. Install true and level. Provide 10" cover over valves, and in accordance with manufacturer's specifications.
 - 3. Install a 10" green plastic valve box over each valve. Fill to middle of valve with gravel.
- I. Wiring:
 - 1. Provide wire from controller to valves. Provide separate wire from controller to each valve. Provide a common neutral wire with white insulation from controller to each valve.
 - 2. Lay wire in trenches provided for piping and tuck underneath piping.
 - 3. Conduit is not required for UF wire, except under paved areas.
 - 4. Make wire connections with waterproofing connectors according to manufacturer's recommendation.
- J. Boxes: All boxes installed flush with grade, boxes installed without distortion so that covers fit snugly into boxes. Boxes installed so that covers do not fit into the box, sit on grade, or rotate or come loose under foot traffic or mower wheels is not acceptable and shall be properly re-set.
- K. Irrigation Controller:
 - 1. Install according to manufacturer's recommendation.
 - 2. Install at location shown on approved drawing, or if not shown, as instructed by Architect.
 - 3. Connect to power supply within EMT conduit, with water-tight fittings. Securely fasten conduit to wall in an approved manner.
 - 4. Install rain and freeze sensors in locations as acceptable to Architect.
- L. Miscellaneous Equipment:
 - 1. Install all assemblies specified herein according to the respective detail drawings or specifications, using best standard practices.
 - 2. Install devices such as rain sensors, flush valves, air relief valves, master valves and flow sensors as indicated on the approved design drawings and as recommended by the manufacturer.

3.04 TESTING

- A. General: Provide Owner's representative a 72 hour notice in advance of required testing and inspections, and final leak test prior to backfilling, should Owner's representative wish to attend.

- B. Sprinkler Main: Test for a period of 12 to 14 hours under normal water pressure. If leaks occur, correct defective construction and repeat test.
- C. Lateral Piping: Test for a period of one hour under normal water pressure. If leaks occur, correct defective construction and repeat test.
- D. Make repairs and repeat testing until no leaks exist.
- E. Complete testing prior to backfilling. Partial backfill may be placed in trenches between fittings to insure stability of line under pressure. Leave fittings and couplings open to visual inspection for full period of test.

3.05 FINAL ADJUSTMENT

- A. Make final adjustments prior to inspection by Architect or Owner's representative.
- B. Completely flush system to remove debris from lines by removing nozzles from heads on ends of lines and turning on system. Replace nozzles and check system operation of each section to ensure no debris will obstruct proper operation. If any head fails to operate properly, repeat entire operation and re-flush.
- C. Valves: Check use of flow adjustment on top of each valve in each section of heads for operating pressure and balance to other sections. Automatic control valves or pressure regulating valves as applicable, are to be adjusted so that the irrigation heads, drip emitters and inline drip tubing operate at the pressure recommended by the manufacturer.
- D. Check all sprinklers for proper operation, coverage, and alignment of throw direction. Prevailing wind conditions or slopes may indicate that arc of angle / trajectory of spray should be other than as shown on approved drawings. Change nozzles to provide correct coverage without additional cost to Owner.

3.06 CLEANING

- A. During work, keep premises neat and orderly. Remove trash and debris daily from site.
 - 1. If site is occupied by Owner, or for irrigation work installed after general site cleaning, maintain drives and paving areas free of dirt and debris from irrigation work on daily basis.

3.07 REPAIRS

- A. Maintenance / Warranty Period Repairs: Contractor shall repair damages sustained to property or equipment. Repairs to Irrigation System must be completed by licensed City-approved irrigator.
- B. Temporary Repairs by Owner: The Owner reserves the right to make temporary repairs as necessary to keep sprinkler system equipment in operating condition. The exercise of this right by the Owner shall not relieve the Contractor of his responsibilities under the terms of the Guarantee, as herein specified.

3.08 DEMONSTRATION

- A. Demonstrate system operation and instruct Owner's personnel in operation and general maintenance of system. Provide required keys and maintenance tools at time of Owner training. Provide as-built drawings and zone map at or before time of Owner training. Provide landscape installer's recommended watering schedule at or before time of training. At conclusion of training, watering program shall be set to landscaper's recommended schedule for establishing plantings.

3.09 MAINTENANCE

- A. Provide maintenance of system, including cleaning / adjustment of heads, raising and lowering of heads, and re-programming of watering schedule, for one year after final acceptance, as part of installation scope.
- B. Address backfill settlement of trenches during one year corrective period.
- C. Drain and flush system at end of one year Guarantee period.
- D. At times as directed by Landscaping installer, adjust watering schedule programming during the maintenance period. Also adjust watering schedule during the maintenance period as required by authorities having jurisdiction for applicable watering restrictions. At end of maintenance period / final acceptance of landscaping, provide recommended continued watering schedule to Owner and set the watering schedule on the controller accordingly unless otherwise directed by Owner.
 - 1. If otherwise required by current watering restrictions of authorities having jurisdiction, set second watering program to comply with the watering restrictions currently in force and set controls to use the compliant watering program.

END OF SECTION 32 84 00

SECTION 32 93 00 - PLANTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Standard Form of Construction Agreement, including General and Special Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 - 1. Plants.
 - 2. Soil Preparation Materials.
 - 3. Miscellaneous Materials.
 - 4. Tree Planting.
- B. Related Sections include the following:
 - 1. Division 32 Section "Irrigation System"

1.03 DESCRIPTION

- A. Provide complete landscaping shown on Drawings.

1.04 QUALITY ASSURANCE

- A. Provide plant materials in compliance with applicable State and Federal laws relating to inspection for diseases and insect infestation at growing site.
- B. Observation at growing site does not preclude right of rejection at job site. Plants damaged in transit or at job site may be rejected.
- C. Off-site sandy loam testing (paid by Landscape Contractor):
 - 1. Provide source of sandy loam soil to Architect for purpose of soil investigation.
 - 2. Test soil samples from both sources of pH, alkalinity, total soluble salts, porosity, sodium content, and organic matter.

1.05 REFERENCED STANDARDS

- A. American Standard for Nursery Stock, approved October 27, 1980 by American National Standards Institute, Inc.
- B. Hortus Third, 1976 - Cornell University

1.06 SUBMITTALS

- A. Division 01: Section - Submittal Procedures
- B. Samples: Submit for approval sufficient representative quantities of sandy loam, sharp sand, bark chips, peat moss, filter fabric and gravel. Samples shall be approved by Architect before use on project.
- C. Submit three representative samples of each of the specified ornamental trees, shrubs, and ground cover plants for Architect's approval. When approved, tag, install and maintain as representative samples for final installed plant materials.
- D. File Certificates of Inspection of plant material by State and Federal authorities with Architect, if required by State.

1.07 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Preparation for Delivery:
 - 1. Balled and Burlapped (B&B) Plants: Dig and prepare shipment in a manner that will not damage roots, branches, shape, and future development.
 - 2. Container Grown Plants: Container shall be sufficiently rigid to hold ball shape and protect root mass during shipping.
- B. Delivery:
 - 1. Packaged materials delivered in containers showing weight, analysis and name of manufacturer. Protect materials from deterioration during delivery and while stored at site.
 - 2. Do not deliver more plant materials than can be planted in one day unless adequate storage and watering facilities are available on job site.
 - 3. If balled plants cannot be planted within 24 hours after delivery to site, protect root balls by heeling in with saw dust or other approved material.
 - 4. Protect during delivery to prevent damage to root ball or desiccation of leaves.
 - 5. Notify Architect of delivery schedule 48 hours in advance so plant material may be observed upon arrival at job site.
 - 6. Remove rejected plant material immediately from site.
 - 7. Do not lift, move, adjust to plumb, or otherwise manipulate plants by trunk or stems.

1.08 JOB CONDITIONS

- A. Planting Restrictions: Perform actual planting only when weather and soil conditions are suitable in accordance with locally accepted practice.
- B. Protections:
 - 1. Do not move any equipment over existing or newly placed structures without approval of Architect and General Contractor. Provide necessary protections such as board-roading as required.

2. Protect other improvements from damage, with protection boards, ramps and protective sheeting as required.
- C. Utilities:
1. Determine locations of underground utilities and perform work in a manner which will avoid possible damage. Hand excavate, if required, to minimize possibility of damage to underground utilities. Maintain grade stakes set by others until removal is mutually agreed upon by parties concerned.

1.09 WARRANTY

- A. Warranty plants and trees for one year after substantial completion. Following Warranty Period Inspection, replace dead materials and materials not in vigorous, thriving condition as soon as weather permits and on notification by Architect. Replace plants, including trees, which in the opinion of the Architect, have partially died, thereby damaging shape, size or symmetry.
- B. Contractor shall replace plants and trees with same kind and size as originally planted and dispose of dead material at no cost to Owner. Provide one-year guarantee on replacement plants. Trees should be replaced at start of next planting or digging season. In such cases, remove dead trees immediately. Protect irrigation system and other piping conduit or other work during replacement. Repair any damage immediately.
- C. Guarantee excludes replacement of plants because of injury by storm, freeze or neglect by Owner.
- D. Provide explicit maintenance and care instructions of all plant material.

PART 2 - PRODUCTS

2.01 PLANTS

- A. General: Plants shall be equal to well-formed No. 1 grade or better nursery stock in accordance with requirements of applicable standards and as noted herein subject to Architect's approval. Listed plant heights are from tops of root balls to nominal tops of plants.
- B. Ground Covers: Nursery grown, healthy, vigorous, of normal habit of growth for species, free from disease, insect eggs and larvae.
- C. Ornamental Trees and Shade Trees: Healthy, vigorous, full-branched, well-shaped, trunk diameter and height requirements as specified. Balls shall be firm, neat, slightly tapered and well burlapped. Trees with loose or broken balls at time of planting shall be rejected. Trees will be individually approved by Architect.

2.02 TURFGRASS SOD

- A. Turfgrass Sod: Approved Number 1 Quality/Premium, including limitations on thatch, weeds, diseases, nematodes, and insects, complying with "Specifications for Turfgrass Sod Materials" in TPI's "Guideline Specifications to Turfgrass Sodding." Furnish viable sod of uniform density, color, and texture, strongly rooted, and capable of vigorous growth and development when planted.
- B. Turfgrass Species: ASPA Nursery growth cultivated Bermuda sod with strong fibrous root system, free of stones, burned spots and minimal weed.

2.03 HYDRO-MULCH

- A. Grass: Bermuda Seed: Shall be extra hulled and treated lawn type seed, delivered to the site in its original unopened container, and shall meet Texas State Law requirements.
- B. Fiber: Shall be one hundred (100%) percent Wood Cellulose Fiber, delivered to the site in its original unopened container, Conweb or equal.
- C. Fiber Track: Shall be delivered to the site in its original unopened container, and shall be Terra-Tack Once, as manufactured by Grass Growers, Inc., or equal.

2.04 SOIL PREPARATION MATERIALS

- A. Sandy Loam:
 - 1. Friable, fertile, dark, loamy soil, free of clay lumps, subsoil, stones, and other extraneous material. Reasonably free of weeds and foreign grasses. Soil containing Dallis grass or Nutgrass shall be rejected.
 - 2. Physical properties as follows:
Clay - between 7-27 percent Silt - between 28-50 percent Sand - less than 52 percent
- B. Sharp Sand: Clean, washed sand, fine to coarse sizes.
- C. Commercial Fertilizer: Commercial fertilizer shall be a complete fertilizer with an organic base. It shall be uniform in composition, dry, and free-flowing. Fertilizer shall be delivered to the site in the original unopened containers, each bearing the manufacturer's guaranteed statements of analysis, and shall meet the following requirements, or equal, for approval.

2.05 MISCELLANEOUS MATERIALS

- A. Steel Edging: 1/8" x 4" DuraEdge". Color Green.
- B. Wrapping Material: Waterproofed, asphalt based paint with antiseptic properties, manufactured for use on tree wounds.
- C. Tree Paint: Waterproofed, asphalt based paint with antiseptic properties, manufactured for use on tree wounds.
- D. Mulch: Cypress bark decorative mulch rated 2 inch to 3 inches. Color to be selected by Architect.

- E. River Rock: Uniform native tan/beige color range, smooth shaped, graded 2-3 inches in size.
- F. Pea Gravel: Washed 3/4 inch native pea gravel.
- G. Guying Materials:
 - 1. Tie Wire: 12 gauge galvanized wire.
 - 2. Black Hose: 2 ply, fiber reinforced hose, minimum 1/2 inch inside diameter.
 - 3. Eye Bolts: Galvanized steel, 3/8 inch eye, 6 inches long.
 - 4. Turnbuckles: Galvanized steel, 3/8 inch eye, 6 inch opening.
 - 5. Steel T Posts: 48 inch length.
 - 6. Colored flag attached to tie wire
- H. Transite Edging: 3/8 Inch thick by 24 inches deep by 42 inches long corrugated transite edging.
- I. Weed Stopper: "Professional Landscape Fabric", 3 oz Spunbond by Fabriscape, Chicago, IL
- J. Erosion Control Netting: "Fabrijute", Photo/Bio-degradable netting by Fabriscape, Chicago, IL
- K. Perforated PVC pipe 4"
- L. Perforated PVC pipe with cap 3"

PART 3 - EXECUTION

3.01 INSPECTION

- A. Examine subgrade upon which work is to be performed, verify grade elevations, that bed areas are left four inches low, observe conditions under which work is to be performed, and notify General Contractor of unsatisfactory conditions. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Contractor. Notify Architect before proceeding.

3.02 TURF AREA PREPARATION

- A. Limit turf subgrade preparation to areas to be planted.
- B. Newly Graded Subgrades: Loosen subgrade to a minimum depth of 4 inches. Remove stones larger than 2 inches in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
 - 1. Apply superphosphate fertilizer directly to subgrade before loosening.
 - 2. Spread topsoil, apply soil amendments and fertilizer on surface, and thoroughly blend planting soil.
 - a. Delay mixing fertilizer with planting soil if planting will not proceed within a few days.
 - b. Mix lime with dry soil before mixing fertilizer.

3. Spread planting soil to a depth of 4 inches but not less than required to meet finish grades after light rolling and natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.
 - a. Spread approximately 1/2 the thickness of planting soil over loosened subgrade. Mix thoroughly into top 2 inches of subgrade. Spread remainder of planting soil.
 - b. Reduce elevation of planting soil to allow for soil thickness of sod.
- 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. 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 planting soil mix proportions and mix thoroughly into top 4 inches of soil. Till soil to a homogeneous mixture of fine texture.
 - a. Apply superphosphate fertilizer directly to surface soil before loosening.
 3. Remove stones larger than 2 inches in any dimension and sticks, roots, trash, and other extraneous matter.
 4. Legally dispose of waste material, including grass, vegetation, and turf, off Owner's property.
- D. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade to within plus or minus 1/2 inch of finish elevation. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit finish grading to areas that can be planted in the immediate future.
- E. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.
- F. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.03 SODDING

- A. Lay sod within 24 hours of harvesting. Do not lay sod if dormant or if ground is frozen or muddy.
- B. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to subgrade or sod during installation. Tamp and roll lightly to ensure contact with subgrade, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.
 1. Lay sod across angle of slopes exceeding 1:3.
 2. Anchor sod on slopes exceeding 1:6 with wood pegs spaced as recommended by sod manufacturer but not less than 2 anchors per sod strip to prevent slippage.
- C. Saturate sod with fine water spray within two hours of planting. During first week after planting, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches below sod.

3.04 GRASS AREAS

A. Lawn areas as indicated on plan, or existing lawn areas disturbed by construction activity shall be hydro-mulched. Hydro-mulch with Bermuda at the rate of two pounds per 1,000 SF. Fertilizer component of hydro-mulch shall be 20 pounds per 1,000 SF (16-20-0 Fertilizer. Mulch component of hydro-mulch shall be wood cellulose fiber at the rate of 50 pounds for 1,000 square feet.

1. If hydro-mulch is to be planted during winter months, inform the Architect and coordinate potential alternate grass type.

B. Areas to receive sod as indicated on plan shall be laid on prepared moistened surface within 48 hours of harvesting and immediately upon delivery to site. Lay sold tight with no open joints visible, and no stretching or overlapping: stagger end joints by 12" minimum. Lay smooth with top elevation ½" below adjoining paving. Water immediately after installation.

3.05 BED PREPARATION

A. Provide additional four inches of excavation for shrub beds and backfill eight inches deep; four inches deep for ground cover.

1 part sandy loam

1 part peat moss

1 part sharp sand

Add four pounds commercial fertilizer, as determined by testing, per 100 SF of bed area and mix thoroughly.

3.06 PLANT SPACING

A. Place plants in position on bed areas before containers have been removed. Obtain approval from Architect. Do not remove burlap from BB plants. Plant where located, setting plants with tops of balls even with tops of beds, and compact soil carefully around each plant ball. Water each plant thoroughly with hoses to eliminate air pockets. Carefully prune plants to remove dead or broken branches and hand-rake bed areas to smooth even surfaces. Architect reserves right to interchange or shift locations of plants prior to planting.

3.07 TREE PLANTING

A. Ornamental Trees: Plant trees in pits 12 inches larger than tree ball, backfill with prepared soil as defined above.

B. Shade Trees:

1. Plant in tree pits 2'-0" greater in diameter than root balls or to edge of tree leave-outs in paved areas. Remove excavated soil from site.

2. Coordinate with electrical contractor in cases where tree uplights are to be installed.

3. For those trees indicated on plans, slope bottom of tree well excavation to drain to sump. Install six inches of pea gravel in bottom of tree well. Provide single layer of filter fabric over gravel. Center tree in well.
4. Backfill pits with five parts sandy loam to one part peat moss and carefully settle by watering to prevent air pockets.

3.08 TREE GUYING

- A. Complete guying as detailed immediately after trees are planted.

3.09 MULCHING

- A. After planting has been completed and approved by Architect, mulch bed areas with bark mulch, two inches deep.

3.10 EDGING

- A. Install metal edging to separate grass areas from ground cover and bed areas.

3.11 TREE WRAPPING

- A. Wrap nursery grown trees. Extend wrapping from ground to a point immediately below lowest branch of each tree or as directed. Securely fasten in place with tacks or staples, so wrapping will remain in place two years.

3.12 PRUNING OF NEW PLANT MATERIAL

- A. Trees are to be pruned to preserve natural character of plant and in a manner appropriate to its particular requirements in landscape design as determined by Architect. In general, remove at least one-third of wood by thinning branches. Do not cut leaders. Pruning in general shall be heavier on collected than on nursery grown plants. Remove soft wood or sucker growth and broken or badly bruised branches with a clean cut.

3.13 MAINTENANCE BY CONTRACTOR

- A. The Contractor is responsible for maintenance of all trees, shrubs, ground cover and turf, including all necessary watering, cultivating, weeding and spraying until substantial completion of the entire project. Plant materials shall be kept in a healthy and vigorous condition with all bed areas kept neat.
- B. Water will be available on site at no expense to the Contractor. Hose and other watering equipment required for maintenance by Contractor shall be furnished by Contractor at his expense. Additional water will be available as sprinkler system becomes operational, but this in no way relieves the Contractor of maintenance of plant material until acceptance by the Owner.

- C. Grass areas shall be mowed at regular intervals to maintain a maximum height of two inches. Do not cut more than 1/3 of grass blade at any one mowing. Remove clippings after mowing.

END OF SECTION 32 93 00

SECTION 33 06 00 - UTILITY SERVICES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Furnish all labor, materials, services, equipment and appliances required in conjunction with or properly incidental to the furnishing and installation of site drainage system complete as indicated on the Drawings and as specified herein, including:
 - a. Layout of drainage and utility lines
 - b. Excavation for trenching, de-watering and backfilling
 - c. Reinforced concrete drainage structures and related covers, grates and frames
 - d. Connection of drainage piping to existing drainage line
 - e. Lateral drainage lines to locations indicated on Drawings for connection to roof drainage piping
 - f. Water distribution system
 - g. Sanitary sewer system
 - h. Gas distribution system
 - i. Removal of excess excavated material off-site
 - j. Provide trench safety design as required for fire hydrant work.
 - 2. Systems shall start at a point approximately 5 feet beyond the exterior walls of the building and extend to termination unless otherwise indicated on the Drawings.
- B. Related Sections include the following:
 - 1. Division 01 Section "Information Available to Bidders - Geotechnical Report."
 - 2. Division 22 Section "Connection to Building Systems."
 - 3. Division 32 Section "Excavating, filling, grading of site."

1.03 QUALITY STANDARDS

- A. Meet requirements and recommendations of applicable portions of the Standards listed.
 - 1. Applicable publications of local governing authority
 - 2. American Society for Testing and Materials, ASTM.
 - 3. Texas Highway Department Standard Specifications for Construction of Highways, Streets, and Bridges, 1972, THD.
 - 4. Texas Trench Excavation Law.

1.04 SUBMITTALS

- A. Division 1 Section - Submittal Procedures: Procedures for submittals.
- B. Product Data: Submit copies of manufacturer's literature showing details of fabrication and installation of valves, vaults, clean-out boots, fire hydrants, flush hydrants, concrete pipe, joint materials, covers, grates and frames.
- C. Shop Drawings: Submit manufacturer's data showing details of precast concrete structures related with site drainage.
- D. Certification: Furnish Owner a certification from pipe manufacturer stating that pipe conforms to Specification requirements.

1.05 TESTING

- A. Listed herein a minimum testing requirements. Cost for making these tests will be paid for by the Contractor.
- B. Backfill: One laboratory test, TEX 114-E, for soil density shall be made for each type of soil used as backfill material. When a test has been made previously on similar soil, a duplicate test will not be necessary.
- C. Reinforcing Steel: Furnish the Architect a certification from the steel fabricator or manufacturer stating that reinforcing steel conforms to Specification requirements.
- D. Portland Cement Concrete: Contractor may use mix design currently being used which meets Specification requirements. In lieu of this, provide samples of materials proposed for use in Portland Cement concrete. Testing laboratory will determine that cement and aggregates meet requirements of these Specifications. Laboratory shall then prepare mix design which conforms to Specifications. New mix design will be required if materials are changed or if concrete does not meet strength or workability requirements.

PART 2 - PRODUCTS

2.01 CONCRETE PIPES FOR STORM SEWER SYSTEM

- A. Reinforced - ATSM C76 Class III Joints -
 - 1. Pipe of 12" diameter and over - Tongue and groove with neoprene or other approved gasket.
 - 2. Fittings and specials - Gasket type joints as required for pipe being connected.

2.02 CONCRETE STRUCTURES

- A. Portland Cement: Shall be of a standard brand and shall conform to the latest ASTM designation C150, Type 1.
- B. Aggregates for concrete: Fine or coarse aggregate and shall meet the requirements of THD, Item 421.
- C. Concrete: Composed of Portland Cement, coarse aggregate, fine aggregate, water, mineral filler and/or admixtures, if permitted by the Architect. Concrete shall have a minimum compressive strength at 28 days of not less than 3000 psi and shall have a maximum water-cement ratio of 7.0 gallons per sack, minimum cement content of 5.0 sacks per cubic yard, and a slump from two (2) to three (3) inches. Measuring materials, batching, and mixing shall conform to ASTM Designation C94.
- D. Reinforcing Steel: Conforming to ASTM Designation A615 of grade 40 or 60.
- E. Cast Iron Rings, Covers, and Grates: Shall be true to pattern in form and dimensions, free from pouring faults, sponginess, cracks, blow holes, and other defects in positions affecting their strength and value for the service intended. Angles shall be filleted and arises shall be sharp and true. Surfaces shall be machined where indicated or where otherwise necessary to secure true, flat surfaces. Covers and grates shall fit properly into frames, and seat uniformly and solidly.
 - 1. Castings: Conforming to the following ASTM Designation:

Gray-Iron Castings	A48 Class 50
Malleable Castings	A47 35018
Ductile Iron Castings	A395 60-45-15
 - 2. Trench Drain: Neenah Foundry Co. Type R-4990-C (Type A, B, or C Grate openings) with Type L Frame, or approved equal.

F. Inlets: Precast concrete inlets as indicated on the Drawings or approved equal.

2.03 CAST IRON PIPE

- A. U.L. approved and accepted by State Fire Insurance Commission without penalty. Manufactured in accordance with Federal Specification WW-P-42, AWWA C1-6-53 (ASA A21.6) or AWWA C108-53 (ASA A21.8), Class 150. Centrifugal cast pipe shall have metal thickness based on tensile strength of 18,000 pounds per square inch and modulus of rupture of 40,000 pounds per square inch. It shall be designed for five foot cover, trench condition B. For any variation in the above physical strength values, there shall be a corresponding variation in metal thickness based on the ASA approved formula in Manual for Computation of Strength and Thickness of Cast Iron Pipe (A21.1- 1939).
1. Joints: One of the following types:
 - a. Push-On: AWWA C111 rubber gaskets and lubricant.
 - b. Mechanical: AWWA C111 ductile iron or gray-iron glands, high strength bolts and nuts and rubber gaskets.
 2. Gasket:
 - a. American-Fastite Joint
 - b. Lone Star-Bell-Tite Joint
 - c. U.S.-Tyton
 - d. or approved equal.
 3. Fittings: AWWA C100-08 or C110-53 (ASA A21.10) bell and spigot type Class D, or AWWA C111-53 (ASA A21.11) mechanical joint type.
 4. Lining: Outside tar coated, inside cement lined and sealed in conformance with AWWA C104-53 (ASA A21.4) except that cement lining may be half thickness in conformance with Federal Specification WW-P-421.
 5. Solder Filler Metal: ASTM B32, Alloys Sn 95, Sn 94, ORE.

2.04 STEEL PIPE

- A. Standard line pipe with plain ends, beveled for welding in random lengths, with welded fittings such as tube turns of same thickness as the pipe, unless otherwise required.
1. Flanges for connecting to valves - Forges steel welding neck designed for 150 PSI pressure, unless indicated otherwise.
 2. Gaskets - 1/16" thick
 - a. American Standard
 - b. Rainbow
 - c. or approved equal.
 3. Tees for connecting service lines to main:
 - a. For new empty mains: Mueller Brass Co., H-17701 and 17500 or approved equal butt-welded type.
 - b. For existing mains in use: Mueller Brass Co., H-17570 or approved equal.
 - c.

2.05 PVC PIPING AND FITTING ASSEMBLY

- A. Piping and Fittings: PVC plastic pipe AWWA C900, class 150 or 200 for water piping and provide with bell end and ASTM F 447 elastomeric seal gasket and plain end for PVC elastomeric gasket fittings. ASTM D 3034, SDR 35 for sewer piping.
- B. Gaskets: ASTM F 477, elastomeric seal.
- C. Solvent: ASTM D 2564, use type and procedures recommended by pipe manufacturer to make solvent-welded joints. Thoroughly clean pipe and fitting of dirt, dust, and moisture before applying solvent.

- D. PVC to Metal Connection: Work metal connection first. Use a non-hardening pipe dope such as Permatex No. 2 on threaded PVC to metal joints. Use only light wrench pressure.
- E. Threaded PVC Connection: Where required, use threaded PVC adapters into which pipe may be welded.
- F. Plastic Underground Warning Tapes: Polyethylene plastic tape, 6 inches wide by 4 mils thick, solid green in color with continuously-printed caption in black letters "CAUTION - SEWER LINE BURIED BELOW."

2.06 FIRE HYDRANTS

- A. Conforming to AWWA Standard C 502-54 dry barrel type traffic mode with 5" minimum diameter valve opening. Mueller Brass Co. - A -24123, or approved equal.

2.07 TAPPING SLEEVE AND VALVE

- A. Suitable for tapping cast iron water main under pressure and having a mechanical end joint. Kennedy Valve Company - 950X, or approved equal.

2.08 GATE VALVES

- A. Water distribution - Designed for 150 pounds per square inch minimum working pressure. End design to conform to piping design. Clear waterway through valve shall equal nominal diameter of the valve. Valve shall have a 2" square operating nut turning counter clockwise to open with direction indicated by an arrow cast in the metal.
 - 1. Sizes less than 2" - Of brass conforming to Dereal Specifications WW-V-54, Type 1, Class B.
 - 2. Sizes 2" to 4" - Having cast iron body, brass-mounted, conforming to Fed Spec WW-X-58, Class A or AWWA standard C500, double disk type, non-rising stem.
 - 3. Sizes 4" and larger for fire protection - Nonrising Stem, UL 262, FM approved, iron body and bonnet with flange for indicator post, bronze seating material, inside screw, 175-psig (1200 kPa) working pressure, mechanical joint ends. Provide with flanged ends for pit installation.
- B. Gas system - Cast iron wading type with cover marked "G" or "GAS"
- C. Gas Distribution - Double disc type with parallel seat, non-rising stem, bronze mounted, with flanged end, designed for 176 pounds per square inch minimum working pressure. Mueller Brass Co. - A-2483-6, or approved equal.

2.09 STOP COCKS

- A. Cast iron body, designed for 125 pounds per square inch working pressure. Mueller Lub O SEAL, H-11170 and H-11175, or approved equal.

2.10 VALVE BOXES

- A. Water system - Of cast iron complete with lock-type cover operated by a special wrench and having the word "WATER" cast in the cover. Boxes shall be of the extension type with screw or slide-type adjustment and with flared base. Metal shall be 3/16" minimum thickness.

2.11 CLEAN OUT BOOTS

- A. Cast -iron ferrule and countersunk brass cleanout plug, with round cast iron access frame and heavy duty, secured, scoriated cast iron cover shall be Trinity Valley 1684, or approved equal.

2.12 BACKFILL MATERIAL:

- A. Borrow: Reused excavated or equal borrow material; low expansiveness, uniform in grade, free from organic materials, capable of being compacted to 95 percent maximum density at optimum moisture content; ASTM D-698.
 - 1. Sand: Natural river or bank sand; free of silt, clay, loam, friable or soluble materials, and organic matter; graded in accord with ASTM C136.
- B. Bedding:
 - 1. Washed gravel, 1/4" to 1-1/2" in size.
 - 2. Screened pit run gravel passing 1-1/2" sieve and retained on 1/4" sieve.
 - 3. Pea gravel passing 5/8" sieve and retained.

PART 3 - EXECUTION

3.01 GENERAL

- A. The Contractor shall furnish all labor, tools, materials and incidentals required to complete the work.
- B. The Contractor shall lay out all work included herein and shall determine the elevations of existing piping at all tap locations and furnish that data to the Owner for review of flow capacity.

3.02 EXCAVATION:

- A. The Contractor shall excavate all materials encountered regardless of the difficulties encountered. The ditch shall be no greater in width or depth than is necessary to permit construction in accordance with the plans and specifications. The maximum width of trench at top of pipe without sheeting, shoring and bracing shall be the external diameter of the pipe plus eight inches.
- B. The Contractor shall determine the need for sheeting and bracing to safeguard the workmen. When sheeting and bracing are necessary the trench or excavation shall be dug to such width that proper allowance is made for the space occupied by the sheeting. All sheeting, shoring and bracing shall have sufficient strength and rigidity to withstand the pressure exerted and protect all persons or property from injury or damage. Sheeting, shoring and bracing shall not be left in place, but shall be removed in such a manner as not to endanger or damage new or existing structures. All holes or voids left by the removal of sheeting shall be backfilled.
- C. Soft, Spongy or otherwise unstable material which will not provide a firm foundation for the pipe shall be removed and replaced with suitable material from the excavation or other sources approved by the Architect and shall be compacted as provided for in the Specifications. When unstable conditions are not corrected by the above means, the Contractor will be required to use rock, gravel, concrete or timber foundations. The type of foundation shall be determined by the Architect. There will be no extra compensation for this work.

3.03 BEDDING:

- A. Trenches for pipe shall be excavated to a minimum depth of three inches below the grade of the outside of the pipe. Trenches shall then be filled up to and around the pipe exterior for at least 15 percent of its overall height with one of the following materials:
- B. Other type of bedding shall be provided when designated on the Drawings.

3.04 BACKFILL:

- A. After the pipe has been installed, selected material from the excavation at a moisture content with which the required density can be obtained shall be placed equally along both sides of the pipe in layers not exceeding six inches loose depth. Care shall be taken to insure

thorough compaction of the fill under the haunches of the pipe. Each layer shall be thoroughly compacted by hand or pneumatic tampers until the fill has reached an elevation 12" above the top of the pipe. The remainder of the backfill shall be placed in layers not exceeding 10" loose depth and shall be compacted by an approved method which will obtain the density of the adjacent undisturbed soil. Backfill for utilities under pavements and curbs and gutters shall be compacted in 6" layers to a density not less than 95 percent of maximum density at optimum moisture content of Standard Proctor Density. Water jetting will not be permitted.

1. Structures: Place backfill, as far as possible, as the work progresses, evenly on all sides of the structure. Remove forms, shoring, sheeting, bracing, etc., before starting to backfill and do not backfill against concrete until directed, which in general shall be at least 7 days after placement. Take care to prevent any wedging action of backfill against structure.

3.05 STORM SEWER SYSTEM

- A. No pipe shall be laid until it has been inspected and approved. All pipe shall be laid and jointed in the dry. The pipe shall be laid up-grade beginning at the lower end of the line. Pipe shall be laid accurately to line and grade. When the entire pipe has been checked for line and grade, the body of the pipe shall be back-filled with enough earth or concrete on both sides to hold the pipe firmly in position.
- B. Wye Connections: The connection of one pipe to another may be accomplished with a precast wye or by means of pipe-to-pipe connection. A pipe-to-pipe connection shall be made by cutting a hole in the larger pipe slightly larger than the outside diameter of the pipe to be connected. The smaller pipe to be connected shall not project into the larger pipe. A concrete collar not less than 6" thick and 6" wide shall be placed around the smaller pipe on the exterior surface of the larger pipe.
- C. End-to-end Connections: Whenever a smaller pipe is jointed end-to-end to a larger pipe, the inside tops of the two pipes shall be matched. The void between the pipes shall be filled with cemented brick work or where this is not possible the void shall be filled with concrete or mortar. In either case, a concrete collar not less than 6" thick and 6" wide shall be placed over the joint.

3.06 SANITARY SEWER SYSTEM

- A. Pipe: As required per City specification.
- B. Location: Where specific dimension is not shown, sewer shall be located at least 10' horizontally from any water supply or service line. Crossing above water lines: Construct gravity sewers which pass over water lines of Cast Iron Pipe for a distance of 9' each side of the crossing. No joint shall occur within 3' each side of the crossing.
- C. Laying Pipe: Shape the bottom of the trench to give substantial uniform circumferential support to the lower fourth of the pipe. Lay pipe proceeding upgrade with the spigot ends of the bell and spigot pipe and the tongue ends of tongue and groove pipe pointing in the direction of flow. Lay each section true to line and grade in such a manner as to form a close concentric joint with the adjoining pipe and to prevent sudden offsets of the flow lines. As the work progresses, clear the interior of the pipe of all dirt and superfluous material. Where cleaning after laying is difficult due to small pipe size, keep a suitable swab or drag in the pipe and pull it forward past each joint immediately after the jointing is complete. When work is not in progress, plug the ends closing them by another approved method. If maximum width of the trench at the top of the pipe exceeds the specified dimension for any reason other than by direction, provide at no additional cost such concrete cradling, pipe

encasement or other bedding as may be required to satisfactorily support the added load of backfill.

- D. Infiltration: Leakage into the sewer shall not exceed 500 gallons per inch of nominal diameter per day per mile of pipe for any section between successive manholes. If the infiltration rate does not appear to be acceptable, measure the amount of leakage with a suitable weir or other device as directed. If the measured rate of infiltration exceeds the acceptable maximum, make correction in the system until it becomes acceptable.
- E. Manholes: Construct manholes of precast concrete sections or of brick. Covers and frames shall be of cast iron. Invert channels shall be smooth and semi-circular in shape, conforming to the inside of the adjacent sewer section. Make changes in direction of flow with a smooth curve of as large a radius as the manhole size will permit. Changes in size and grade of the channels shall be made gradually and evenly. Form the invert channels directly in the concrete of the manhole base or by use of a half tile laid in concrete, or by laying full-section sewer pipe through the manhole and breaking out the top half after surrounding concrete has hardened. The floor of the manhole outside the channels shall be smooth and shall slope toward the channels not less than 1" per foot nor more than 2" per foot. Free drop inside the manhole shall not exceed 2'-6" measured from the invert of the inlet pipe to the top of the floor of the manhole outside the channels. Construct drop manholes whenever the free drop would otherwise be greater than 2'-6". In all manholes, provide steps of cast iron. Width of steps shall not be less than 10", set them approximately 15" apart and with alternate steps offset 6". Rungs of 7/8" diameter wrought iron, galvanized after fabrication, may be substituted for steps and may be installed without offset if the crossbar is not less than 14" long. Rungs shall be formed so that crossbar is sufficiently below plane of side bar to prevent foot from slipping off. Provide not less than 6-1/2" of toe room at each rung, measured from inside face of the crossbar.
- F. Clean-outs and Stacks: Use pipe of the same material as the mainline and of 6" diameter unless shown otherwise. Provide removable standard pipe plugs.
- G. Testing: Sewer mains will be checked to determine any displacement of the pipe after trench has been backfilled 2' above the pipe and compacted. Testing shall be with a light flashed between manholes or manhole location. If poor alignment or displacement or other defects are discovered, they shall be corrected as directed.

3.07 WATER DISTRIBUTION SYSTEM

- A. Pipe Material and Preparation: Use PVC pipe. Before lowering pipe into trench, clean the interior of all foreign matter, inspect the pipe for defects. Defective, damaged or unsound pipe must be removed from the site.
- B. Laying Pipe: The full length of each pipe section shall rest solidly upon the pipe bed with recesses excavated to accommodate bells and joints. Keep pipe interior clean and dry during laying operations. When work is not in progress, plug the ends or close them by another approved method. Do not lay pipe with bells facing in direction of laying. Do not lay pipe closer than 10' to a sewer. At cross-overs with sewers, no joint in the water line shall be closer than 9' from the cross-over point. Where possible, lay water lines 6' above sewers at cross-overs. Provide valves, plugs or caps, as required, where pipe ends are left for future connections. Deflections from a straight line or grade as required by vertical or horizontal curves of off-sets shall not exceed 6/D inches per lineal foot of pipe, between the center lines, extended, of any 2 connecting pipes. D represents the nominal pipe diameter in inches. If alignment requires deflection in excess of this limitation, use special bends or a sufficient number of shorter lengths of pipe to provide angular deflections within the limits.
- C. Cutting Pipe: Use an approved type of mechanical cutter. Use wheel cutters when practical.

- D. Pipe Joints: Install Mechanical Joints according to joint manufacturer's recommendations. Center the spigot in the bell, push the pipe in position and bring it into required alignment.
- E. Valves: Where feasible, locate valves outside the area of roads and streets. Set valves plumb. Unless shown otherwise, provide a valve box over each outside gate valve. Box shall be of such length as will be adapted, without full extension, to the depth of cover required over the pipe at its location. Center the box on the valve. Carefully tamp earth fill around the box to a distance of 4' on all sides or to the undisturbed trench face if less than 4'.
- F. Fire Hydrants: Set the hydrant plumb and at such elevation that the connecting pipe will not have less cover than the distributing mains. Provide a concrete slab for the hydrant as required. Secure the hydrant to prevent it from blowing off the line with a concrete thrust block set between the back of the hydrant, opposite the pipe connections, and the vertical face of the trench. If the character of the soil is such that the hydrant cannot be wedged in this manner, provide bridle rods and rod collars of not less than 3/4" stock and protect them with a coating of acid resisting paint. Place at least 5 cubic feet of broken stone around the hydrant base to insure drainage. Thoroughly compact the backfill around hydrants to grade.
- G. Flush Hydrants: Install where required so as to be flush with finished edge.
- H. Meter and Meter Vault: Valves and fittings in meter vault shall be bolted flange type with ring gaskets.
- I. Meter Vault: Per City Specifications.
- J. Anchorage of Fittings: Anchor tees, bends and plugs in mains with thrust blocks formed of 2,500 p.s.i. 28 day strength concrete.
- K. Sterilization: Sterilize each unit of completed distribution system, using chlorine, before it is accepted for domestic operation. If possible, flush the lines thoroughly before introduction of chlorinating material. The amount of chlorine shall be such as to provide a dosage of at least 50 parts per million. The chlorinating material shall be introduced into the system by an approved method. It shall remain in the system for a contact period of at least 24 hours and until the pressure test required below is complete. During this time valves in the system shall be opened and closed several times. After the contact period, flush the system with clean water until the residual chlorine content is depleted or not greater than 0.5 part million. Then take Bacteria samples as directed and submit them to the State Health Department Laboratory for analysis. Final results of the test shall indicate no chlorine bacteria present in the samples. Water mains shall meet State Health Department requirements before acceptance.
- L. Testing: During sterilization contact period, test the system. Piping shall have been laid, joints completed and trench partially backfilled but leaving the joints exposed for examination. Unless otherwise required, expel air in the line and subject it to a hydrostatic pressure test of 50 pounds per square inch in excess of the anticipated static pressure at the points of reading when the system is put in operation. Maintain the pressure for one hour. Exposed pipe, joints, fittings, valves and accessories shall be inspected. Tighten or remake defective joints. Replace defective material and repeat the test until results are satisfactory. Conduct open trench tests for 2 hours and covered trench tests for 24 hours. Provide all plugs, valves, pumps, equipment and labor necessary for conducting the tests. Assume responsibility for damage and/or contamination to existing connecting supply mains.
- M. Special Requirements: Where conditions prevent the actual visible inspection of each joint or when the joints are made of a material other than lead such that leakage diminishes as the material in the joints ages, provide a calibrated gauge and meter to determine the quantity of water lost by leakage under normal operating pressure. To be accepted, any leakage (evaluated on a pressure basis of 150 pounds per square inch) must be less than 100 U.S. gallons per 24 hours per mile of pipe, per inch nominal diameter or pipe for pipe in 12 foot lengths, 75 gallons for pipe in 16 foot lengths, and varies proportionately for other pipe

lengths. In calculating leakage, make allowance for added joints in the pipeline above the normal for unit lengths of pipe. Should any test of combined sections of pipeline disclose leakage greater than the acceptable limit, make repairs until the leakage is reduced to, at most, the acceptable limits.

3.08 CLEAN UP

- A. Upon completion of the work covered by this Section, the Contractor shall clean up all work areas by removing all debris, surplus materials, and equipment from the site. The ground surface shall be restored to its original condition as nearly as possible.

3.09 PROTECTION

- A. Properly protect existing utility lines shown on the Drawings from damage due to these operations. If damage occurs, satisfactorily repair it at no additional cost. If damage occurs to an unknown line, give immediate notification.

END OF SECTION 33 06 00

BRW

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