SPECIFICATIONS

UTAH NATIONAL GUARD

PH II SOUTH GARRISON INFRASTRUCTURE

CAMP WILLIAMS, UTAH
DFCM PROJECT NO.: 13240480

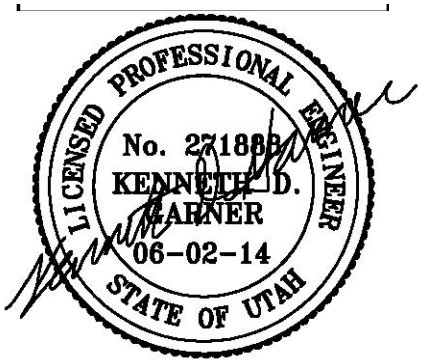
JUNE 23, 2014
PERMIT SET

CODE OFFICIAL STAMP

EFT ARCHITECTS INC.

DOCUMENT 000107 - SEALS PAGE

1.1 DESIGN PROFESSIONALS OF RECORD

ARCHITECT	EFT Architects, Inc.	
CIVIL ENGINEER	Ensign Engineering and Land Surveying	
ELECTRICAL ENGINEER	Ken Garner Engineering, Inc.	

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June 29, 2007
Job No. 0128-008-07

State of Utah
Division of Facilities Construction and Management
4110 State Office Building
Salt Lake City, Utah 84114

Attention: Messrs. Wayne Smith and Scott Potter

Gentlemen:

Re: Report
Preliminary Geotechnical Study
Approximately 20 Acres of Land, East and South of the
Existing Camp Williams Facilities
Bluffdale, Utah
DFCM Project No. 077463

1. INTRODUCTION

1.1 GENERAL

This report presents the results of our preliminary geotechnical study performed at the site of approximately 20 acres located east and south of the existing Camp Williams facilities in Bluffdale, Utah. The general location of the site with respect to major topographic features, existing facilities, and roads as of 1999, is presented on Figure 1, Vicinity Map. A more detailed layout of the site showing the existing facilities and roadways is presented on Figure 2, Site Plan. The locations of the test pits excavated in conjunction with this study are also presented on Figure 2.

1.2 OBJECTIVES AND SCOPE

The objectives and scope of our study were planned in discussions between Messrs. Wayne Smith and Scott Potter of the State of Utah, and Mr. Alan Spilker of Gordon Spilker Huber Geotechnical Consultants, Inc (GSH).

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Gordon Spilker Huber Geotechnical Consultants, Inc.
4426 South Century Drive, Suite 100
Salt Lake City, Utah 84123
Tel: (801) 685-9190 Fax: (801) 685-2990
www.gshgeotech.com

In general, the objectives of this study were to:

1. Define and evaluate the subsurface soil and groundwater conditions across the site.

2. Provide appropriate foundation, earthwork, and pavement recommendations to be utilized in the design and construction of the proposed facilities.

In accomplishing these objectives, our scope has included the following:

1. A field program consisting of the excavating, logging, and sampling of 12 test pits.

2. A laboratory testing program.

3. An office program consisting of the correlation of available data, engineering analyses, and the preparation of this summary report.

1.3 AUTHORIZATION

Authorization was provided by returning an executed copy of GSH's Professional Services Agreement Contract Modification for DFCM Project No. 077463.

1.4 PROFESSIONAL STATEMENTS

Supporting data upon which our recommendations are based are presented in subsequent sections of this report. Recommendations presented herein are governed by the physical properties of the soils encountered in the exploration test pits, projected groundwater conditions, and the layout and design data discussed in Section 2., Proposed Construction, of this report. If subsurface conditions other than those described in this report are encountered and/or if design and layout changes are implemented, GSH must be informed so that our recommendations can be reviewed and amended, if necessary.

Our professional services have been performed, our findings developed, and our recommendations prepared in accordance with generally accepted engineering principles and practices in this area at this time.

2. PROPOSED CONSTRUCTION

It is proposed that various types and sizes of training and production facilities will be constructed within the approximate 20 acres of land located east and south of the existing Camp Williams facilities. The structures are projected to vary from one to two-levels to as many as five to six levels above grade. The structures are anticipated to be constructed slab-on-grade with some of the structures having partial- to full-depth basements. Below grade, the structures will be of

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reinforced concrete construction. Structures are anticipated to be of masonry and/or light steel construction. Anticipated maximum real wall and column loads are projected to range from 2 to 8 kips per lineal foot and 20 to 120 kips, respectively. We project that the floor slab loads will be light (less than an average uniform load of 200 pounds per square foot).

Site-specific geotechnical studies are anticipated to be performed for each proposed structure type within the site boundary.

Development will also include fairly extensive flexible pavements. Ultimate traffic in the roadway areas is projected to consist of a moderate volume of automobiles and light trucks, and occasional medium- and heavy-weight trucks. During construction, the volume of medium- and heavy-weight trucks will be significantly higher.

Site development will require earthwork in the form of cutting and filling. At this time we project that maximum cuts and fills will generally not exceed 8 to 10 feet.

3. SITE INVESTIGATIONS

3.1 FIELD PROGRAM

In order to define and evaluate the subsurface soil and groundwater conditions across the site, 12 test pits were excavated to depths of 12.0 to 18.5 feet with a rubber-tire backhoe. The approximate locations of the test pits are presented on Figure 2.

The field portion of our study was under the direct control and continual supervision of an experienced member of our geotechnical staff. During the course of the field operations, a continuous log of the subsurface conditions encountered was maintained. In addition, samples of the typical soils encountered were obtained for subsequent laboratory testing and examination. The soils were classified in the field based upon visual and textural examination. These classifications have been supplemented by subsequent inspection and testing in our laboratory. Detailed graphical representation of the subsurface conditions encountered is presented on Figures 3A through 3L, Log of Test Pits. Soils were classified in accordance with the nomenclature described on Figure 4, Unified Soil Classification System.

A 2.42-inch inside diameter thin-wall hand sampler was utilized in the subsurface sampling at the site.

Following completion of excavating and logging, each test pit was backfilled. Although an effort was made to compact the backfill with the backhoe, backfill was not placed in uniform lifts and compacted to a specific density. Consequently, settlement of the backfill with time is likely to occur.

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Additionally, one and one-quarter-inch diameter slotted PVC pipe was installed in Test Pits TP-1, TP-4, TP-8, and TP-11 in order to provide a means of monitoring the groundwater fluctuations.

3.2 LABORATORY TESTING

3.2.1 General

In order to provide data necessary for our engineering analyses, a laboratory testing program was performed. The program included moisture and density, collapse-consolidation, partial gradation, and chemical tests. The following paragraphs describe the tests and summarize the test data.

3.2.2 Moisture and Density Tests

To aid in classifying the soils and to help correlate other test data, moisture and density tests were performed on selected samples. The results of these tests are presented on the test pit logs, Figures 3A through 3L.

3.2.3 Collapse-Consolidation Tests

To provide data necessary for our settlement analysis, collapse-consolidation tests were performed upon representative samples of the natural silty clay soils. The collapse portion of the test was performed as follows:

1. Load sample at in-situ moisture content to specific axial pressure.
2. Measure and record axial deflection.
3. Saturate sample.
4. Measure and record resulting collapse.

The test results are tabulated below:

Test Pit No.	Depth (feet)	USCS Soil Type	Natural Dry Density (pcf)	Natural Moisture Content (percent)	Axial Load When Saturated (psf)	Collapse (percent)
TP-2	2.0	CL	89	18.3	1,600	2.2
TP-6	5.0	CL	73	17.3	1,600	9.1
TP-12	6.0	CL	75	15.0	1,600	1.6

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Upon completion of the collapse portion of the tests, standard consolidation test loading was applied to the sample from Test Pit TP-12. The results of these tests indicate that soils tested are collapsible, moderately to highly compressible, and exhibit low to moderate preconsolidation pressures. Detailed results of these tests are maintained within our files and can be transmitted to you, upon your request.

3.2.4 Partial Gradation

To aid in classifying the granular soils, partial gradation tests were performed. Results are tabulated below:

Test Pit No.	Depth (feet)	Percent Passing No. 200 Sieve	Soil Classification
TP-1	12.0	49.1	SM/ML
TP-4	6.0	28.5	SM

3.2.5 Chemical Tests

To determine if the site soils will react detrimentally with concrete, chemical tests were performed on a representative sample of the silty clay soils encountered in Test Pit TP-3 at a depth of three feet below existing grade. The results of the chemical tests are presented below:

Test Pit No.	Depth (feet)	pH	Total Water Soluble Sulfate (ppm)
TP-4	2	7.13	300

4. SITE CONDITIONS

4.1 SURFACE

The site is an undeveloped parcel of approximately 20 acres located east and south of Camp Williams in Bluffdale, Utah. The site slopes downward to the east with a relief of approximately 80 to 120 feet across the site toward the Jordan River. The site has multiple dry washes that flow toward the east and are spread across the rolling surface of the site. The site is covered with sage brush, grasses, and weeds with patchy areas of thick vegetation. Surrounding the site, land use consists of similar undeveloped vacant land with the exception of the existing Camp Williams facility to the north and east, and the Utah Highway Patrol training facility to the south. Along the western boundary of the site is a canal.

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4.2 SUBSURFACE SOIL AND GROUNDWATER

From the surface in Test Pits TP-1 through TP-3, TP-5, TP-6, TP-9, and TP-12 and extending to depths of 5 to 10 feet is silty clay with varying amounts of fine sand. The clay is stiff to very stiff, moist, and light brown. The natural silty clay soils to depths of five to nine feet and possibly deeper across the site contain a "pinhole" structure, which is normally an indicator that the soils are potentially collapsible. The results of our laboratory tests have confirmed that the clay soils containing pinholes are moderately to highly collapsible. Collapsible soils will exhibit relatively high strength and low compressibility characteristics when dry, but lose strength, become highly compressible, and collapse with significant increase in moisture content.

Underlying the clay and extending to the explored depths of 15.0 and 16.5 feet in Test Pits TP-5 and TP-9, respectively, and to the depths of 17.0, 17.0, 13.0, 13.0, and 11.0 in Test Pits TP-1 through TP-3, TP-6, and TP-12, respectively, is silty sand and silty sand/sandy silt. These soils are medium dense, moist, brown, light brown, and are not moisture sensitive.

Underlying the silty sand and silty sand/sandy silt and extending to the depths explored, 18.5, 18.5, and 15.0 feet in Test Pits TP-1 through TP-3 is silty gravel with varying amounts of fine to coarse sand. The gravel is medium dense to dense, moist, brown, and not moisture sensitive.

Underlying the silty/sand in Test Pits TP-6 and TP-12 and extending to the depth explored, 16.5 feet, in each test pit is silty clay with some fine sand. The clay is medium stiff to stiff, moist, brown, gray, and are not moisture sensitive.

From the surface in Test Pits TP-4 and TP-7 and extending to a depth of six and eight feet, respectively, is silty fine and coarse gravel with some fine sand. The gravel is medium dense, moist, brown, and is not moisture sensitive. Underneath the gravel and extending to the explored depth of 14.5 feet in Test Pit TP-4 and to a depth of 11.0 feet in Test Pit TP-7 is silty fine to medium sand. The sand is medium dense, moist, brown, and are not moisture sensitive. Underlying the sand in Test Pit TP-7 and extending to the explored depth of 12.5 feet is silty clay with some fine sand. The silty clay is medium stiff, moist, brown, blocky, and not moisture sensitive.

From the surface in Test Pit TP-8 and extending to a depth of 11 feet is non-engineered fill consisting of silty fine and coarse gravel, landfill debris, trash, and newspapers. Underlying the non-engineered fill and extending to a depth of 14.0 feet is silty clay with some fine sand. The silty clay is medium stiff, moist, brown, blocky, and not moisture sensitive. Underneath the clay and extending to the explored depth of 15.5 feet is silty fine sand. The sand is medium dense, moist, brown, and not moisture sensitive.

From the surface in Test Pit TP-10 and extending to a depth of two feet is silty fine sand. The sand is medium dense, moist, brown, and not moisture sensitive. Underlying the sand is silty fine and coarse gravel with some fine sand. The gravel is medium dense, moist, brown, and not

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moisture sensitive. Underneath the gravel and extending to the explored depth of 12 feet is silty clay with some fine sand. The clay is medium stiff, moist, brown, and not moisture sensitive.

From the surface and extending to the explored depth of 11 feet is silty clay with varying amounts of fine sand. The clay is stiff, moist, brown, and contains white mottling. The natural silty clay soils extending to a depth of approximately five feet contain a "pinhole structure", which is normally an indicator that the soils are potentially collapsible. The silty clay grades blocky and layered at a depth of approximately five feet. The blocky and layered silty clay is medium stiff, moist, brown, and not moisture sensitive.

Groundwater was not encountered in the test pits during excavation operations or during a follow-up visit approximately one week later. Groundwater is not anticipated to affect design or construction of the proposed structures.

5. DISCUSSIONS AND RECOMMENDATIONS

5.1 SUMMARY OF FINDINGS

The most significant geotechnical aspects of the site are:

1. Potentially collapsible soils encountered to depths of up to nine feet and possibly deeper across the site.

2. Non-engineered fill encountered to a depth of 11 feet in the vicinity of Test Pit TP-8.

The results of this study indicate that the proposed structures may be supported upon conventional spread and continuous wall foundations placed on suitable natural soils or structural fill extending to suitable natural soils.

Collapsible soils which extend to depths of eight feet and possibly deeper throughout the site are not suitable and under no circumstances should foundations, floor slabs, rigid pavement, or exterior flatwork be placed over these collapsible soils. In flexible pavement areas, the collapsible soils may remain if properly prepared as discussed later within this report.

Non-engineered fill was encountered to a depth of 11 feet within Test Pit TP-8. The non-engineered fills will exhibit variable and most likely poor engineering characteristics and are not suitable for the support of footings, floor slabs, rigid pavements, or exterior flatwork. The non-engineered fills may remain underneath flexible pavements provided they are prepared as described in Section 5.2.1., Site Preparation.

Collapsible soils appear to be present across much of the site to varying depths. Additionally, non-engineered fill was encountered in isolated areas within the site. Therefore, we recommend

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that a qualified geotechnical engineer observe foundation excavations to identify that all collapsible soils and non-engineered fill have been removed.

In the following sections, detailed discussions pertaining to earthwork, foundations, floor slabs, pavements, and the geoseismic setting of the site are provided.

5.2 EARTHWORK

5.2.1 Site Preparation

Prior to initiation of major construction activities, all collapsible soils, non-engineered fill, surface vegetation, topsoil, and other deleterious materials must be removed from an area which extends five feet beyond the perimeter of the proposed structure, floor slabs, rigid pavements, and exterior flatwork areas.

Potentially collapsible soils and non-engineered fills may remain beneath flexible pavements if they do not contain deleterious materials and are less than two and one-half feet thick. The proper preparation of the collapsible soils and non-engineered fills will consist of the scarification of the upper nine inches, moisture preparation, and compaction to the requirements for structural fill. Even if properly prepared, some long-term movements of flexible pavements overlying the potentially collapsible soils and non-engineered fills may occur. If these long-term movements are not acceptable, the collapsible and non-engineered fills must be completely removed.

Subsequent to the above operations and prior to the placement of footings, structural site grading fill, floor slabs, or pavements, the exposed subgrade must be proofrolled by running moderate-weight rubber tire-mounted construction equipment uniformly over the surface at least three times. If excessively soft or otherwise unsuitable soils are encountered beneath footings, they must be completely removed. In pavement and floor slab areas, unsuitable soils encountered during recompaction and/or proofrolling must be completely removed and replaced with compacted granular structural fill.

Surface vegetation and other deleterious materials should be removed from the site. Topsoil, although unsuitable for utilization as structural fill, may be stockpiled for subsequent landscaping purposes.

5.2.2 Excavations

Temporary construction excavations not exceeding four feet in depth in natural fine-grained clay soils may be constructed with near-vertical sideslopes. Temporary construction excavations not exceeding four feet in depth in natural sand and gravel soils may be constructed with sideslopes no steeper than one-half horizontal to one vertical. Temporary construction excavations not exceeding eight feet in depth in natural fine-grained clay soils may be constructed with sideslopes no steeper than one-half horizontal to one vertical. Temporary construction

excavations not exceeding eight feet in depth in natural sand and gravel soils may be constructed with sideslopes no steeper than one horizontal to one vertical. Excavations deeper than eight feet are not anticipated at the site. If extensive layers of clean granular soils and/or groundwater are encountered, flatter sideslopes, shoring and bracing, and/or dewatering may be required.

All excavations must be inspected periodically by qualified personnel. If any signs of instability or excessive sloughing are noted, immediate remedial action must be initiated.

5.2.3 Structural Fill

Structural fill will be required as site grading fill, as backfill over foundations and utilities, and possibly as replacement fill below footings and slabs. All structural fill must be free of sod, rubbish, construction debris, frozen soil, and other deleterious materials. The maximum particle size within structural site grading fill should generally not exceed four inches; although, occasional particles up to six to eight inches may be incorporated provided that they do not result in "honeycombing" or preclude the obtainment of the desired degree of compaction. Structural site grading fill is defined as fill placed over fairly large open areas to raise the overall site grade. For the site conditions, we recommend that a mixture of sands and gravels containing at least 20 percent fines; that is, either silt or clay particles, be utilized as granular fills. The purpose of the relatively high percentage of fines is to render the compacted material less permeable; thus, reducing the possibility of deep infiltration of surface water runoff into the underlying soil sequence. In confined areas the maximum particle size should generally be restricted to two inches.

Prior to placing structural site grading fill, the subgrade should be proofrolled as discussed in Section 5.2.1, Site Preparation. In confined areas, preparation of the subgrade will consist of the removal of all loose and disturbed soils.

5.2.4 Fill Placement and Compaction

All structural fill should be placed in lifts not exceeding eight inches in loose thickness. Fills 5 to 10 feet thick, and beneath all footings and floor slabs, must be compacted to at least 95 percent of the maximum dry density as determined by the AASHTO[1] T-180 (ASTM[2] D-1557) compaction criteria. Structural fills greater than 10 feet are not anticipated at the site. Fills less than 5 feet thick, which are not beneath an area extending out at least 5 feet from the perimeter of the structure, should be compacted to at least 90 percent of the above-defined criteria.

Prior to the placement of structural site grading fill, pavements, floor slabs, or footings, the exposed subgrade must be prepared as discussed in Section 5.2.1, Site Preperation, of this report. In confined areas, subgrade preparation must consist of the removal of all loose or disturbed soils.

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1 American Association of State Highway and Transportation Officials
2 American Society for Testing and Materials

Non-structural fill may be placed in lifts not exceeding 12 inches in loose thickness and compacted by passing construction, spreading, or hauling equipment over the surface at least twice.

5.2.5 Utility Trenches

All utility trench backfill material below structurally loaded facilities (flatwork, floor slabs, roads, etc.) should be placed at the same density requirements established for structural fill. If the surface of the backfill becomes disturbed during the course of construction, the backfill should be proof-rolled and/or properly compacted prior to the construction of any exterior flatwork over a backfilled trench. Proof-rolling may be performed by passing moderately loaded rubber tire-mounted construction equipment uniformly over the surface at least twice. If excessively loose or soft areas are encountered during proof-rolling, they should be removed to a maximum depth of two feet below design finish grade and replaced with structural fill.

Most utility companies and City-County governments are now requiring that Type A-1 or A-1a (AASHTO Designation – basically granular soils with limited fines) soils be used as backfill over utilities. These organizations are also requiring that in public roadways the backfill over major utilities be compacted over the full depth of fill to at least 96 percent of the maximum dry density as determined by the AASHTO T-180 (ASTM D-1557) method of compaction. We recommend that as the major utilities continue onto the site that these compaction specifications are followed.

The natural fine-grained soils are not recommended for use as trench backfill.

5.3 SPREAD AND CONTINUOUS WALL FOUNDATIONS

5.3.1 Design Data

The proposed structure may be supported upon conventional spread and continuous wall foundations overlying suitable non-moisture sensitive native soils or structural fill extending to these soils. Under no circumstances should the footings be underlain by the potentially collapsible soils or non-engineered fill. For design, the following parameters are provided:

Minimum Recommended Depth of Embedment for Frost Protection	- 30 inches
Minimum Recommended Depth of Embedment for Non-frost Conditions	- 15 inches
Recommended Minimum Width for Continuous Wall Footings	- 18 inches

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Minimum Recommended Width for Isolated Spread Footings	- 24 inches
Recommended Net Bearing Pressure for Real Load Conditions	- 2,000 pounds per square foot
Bearing Pressure Increase for Seismic Loading	- 50 percent

The term "net bearing pressure" refers to the pressure imposed by the portion of the structure located above lowest adjacent final grade. Therefore, the weight of the footing and backfill to lowest adjacent final grade need not be considered. Real loads are defined as the total of all dead plus frequently applied live loads. Total load includes all dead and live loads, including seismic and wind.

5.3.2 Installation

Under no circumstances should the footings be established upon potentially collapsible soils, non-engineered fill, topsoil, loose or disturbed soils, sod, rubbish, other deleterious materials, frozen soils, or within ponded water. If unsuitable soils are encountered, they must be completely removed and replaced with compacted structural fill. If granular soils become loose or disturbed, they must be recompacted to the requirements for structural fill. It is anticipated that the depth and lateral distribution of potentially collapsible soils and non-engineered fill will vary throughout the site.

The width of structural replacement fill below footings should be equal to the width of the footing plus one foot for each foot of fill thickness. If the granular structural fills become loose or disturbed prior to pouring the footings, they must be appropriately compacted.

5.3.3 Settlements

Settlements of footings supporting the structures designed and installed in accordance with the above recommendations should not exceed one-half of an inch.

5.4 LATERAL RESISTANCE

Lateral loads imposed upon foundations due to wind or seismic forces may be resisted by the development of passive earth pressures and friction between the base of the footings and the supporting soils. In determining frictional resistance, a coefficient of 0.40 should be utilized. Passive resistance provided by properly placed and compacted granular structural fill above the water table may be considered equivalent to a fluid with a density of 300 pounds per cubic foot. Below the water table, this granular soil should be considered equivalent to a fluid with a density of 150 pounds per cubic foot.

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A combination of passive earth resistance and friction may be utilized provided that the friction component of the total is divided by 1.5.

5.5 LATERAL PRESSURES

Lateral pressures will be provided as building design and site layout become available.

5.6 FLOOR SLABS

To facilitate construction, we recommend that all at-grade slabs be immediately underlain by a minimum of four inches of "free-draining" granular material, such as "pea" gravel or three-quarter to one-inch minus clean gap-graded gravel. The gravel may be placed directly upon suitable non-moisture sensitive soil and/or granular structural fill extending to suitable non-moisture sensitive natural soil. Settlements of lightly loaded floor slabs will be negligible.

Under no circumstances should the floor slab be established upon potentially collapsible soil, non-engineered fill, loose or disturbed soils, sod, rubbish, topsoil, other deleterious materials, frozen soils, or within ponded water. Floor slab settlements are anticipated to be approximately one-quarter of an inch.

5.7 PAVEMENTS

The natural non-moisture sensitive soils, the potentially collapsible natural soils, and the non-engineered fill encountered at the site will exhibit poor pavement support characteristics when saturated or near saturated. Potentially collapsible soils and non-engineered fills must be removed in the rigid pavement areas and may remain in flexible pavement areas as long as they are less than two and one-half feet thick and are properly prepared as discussed previously in this report.

With the subgrade soils and the projected traffic as discussed in Section 2., Proposed Construction, the pavement sections on the following pages are recommended.

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Primary Roadway Areas

(Light Volume of Automobiles and Light Trucks,
Occasional Medium-Weight Trucks,
and No Heavy-Weight Trucks)
[1 equivalent 18-kip axle load per day]

Flexible:

3.0 inches	Asphalt concrete
7.0 inches	Aggregate base
12.0 inches	Granular subbase/structural site grading fill*
Over	Properly prepared potentially collapsible soils, properly prepared non-engineered fills, suitable natural soils and/or structural fill extending to suitable natural soils

* If potentially collapsible soils are not present no subbase is required.

Rigid:

5.0 inches	Portland cement concrete (non-reinforced)
4.0 inches	Aggregate base
Over	Suitable natural soils and/or structural fill extending to suitable natural soils**

** Under no circumstances shall rigid pavements be established overlying potentially collapsible soils and/or existing non-engineered fills, even if properly prepared.

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Primary Roadway Areas

(Moderate Volume of Automobiles and Light Trucks,
Moderate Volume of Medium-Weight Trucks,
and Occasional Heavy-Weight Trucks)
[5 equivalent 18-kip axle load per day]

Flexible:

3.5 inches	Asphalt concrete
8.0 inches	Aggregate base
12.0 inches	Granular subbase/structural site grading fill*
Over	Properly prepared potentially collapsible soils, properly prepared non-engineered fills, suitable natural soils and/or structural fill extending to suitable natural soils

* If potentially collapsible soils are not present no subbase is required.

Rigid:

6.0 inches	Portland cement concrete (non-reinforced)
4.0 inches	Aggregate base
Over	Suitable natural soils and/or structural fill extending to suitable natural soils**

** Under no circumstances shall rigid pavements be established overlying potentially collapsible soils and/or existing non-engineered fills, even if properly prepared.

For dumpster pads, we recommend a pavement section consisting of six and one-half inches of Portland cement concrete, four inches of aggregate base, over suitable natural non-moisture sensitive soils or structural site grading fills extending to suitable natural non-moisture sensitive soils.

These rigid pavement sections are for non-reinforced Portland cement concrete. Construction of the rigid pavement should be in sections 10 to 12 feet in width with construction or expansion joints or one-quarter depth saw-cuts on no more than 12-foot centers. Saw-cuts must be completed within 24 hours of the "initial set" of the concrete and should be performed under the

draft

direction of the concrete paving contractor. The concrete should have a minimum 28-day unconfined compressive strength of 4,000 pounds per square inch and contain 6 percent ±1 percent air-entrainment.

5.8 CEMENT TYPE

The chemical tests from study indicate that the tested soils contain a positive percentage of water-soluble sulfates. Based upon this data, Type II sulfate resistant cement will be required for concrete in contact with the site soils.

5.9 GEOSEISMIC SETTING

5.9.1 General

Utah municipalities adopted the International Building Code (IBC) 2006 on January 1, 2007. The IBC 2006 code determines the seismic hazard for a site based upon 2002 mapping of bedrock accelerations prepared by the United States Geologic Survey (USGS) and the soil site class. The USGS values are presented on maps incorporated into the IBC code and are also available based on latitude and longitude coordinates (grid points).

The structures must be designed in accordance with the procedure presented in Section 1613, Earthquake Loads, of the IBC 2006 edition.

5.9.2 Faulting

Based upon our review of available literature, no active faults are known to pass through or immediately adjacent to the site. The nearest active fault is the Wasatch Fault, which is located approximately six miles to the northeast.

5.9.3 Site Class

For dynamic structural analysis, the Site Class D –Soft Soil profile as defined in Table 1613.5.2, Site Class Definitions, of the IBC 2006 can be utilized.

5.9.4 Ground Motions

The IBC 2006 code is based on 2002 USGS (United States Geologic Survey) mapping, which provides values of short and long period accelerations for the Site Class B-C boundary for the Maximum Considered Earthquake (MCE). This Site Class B-C boundary represents a hypothetical bedrock surface and must be corrected for local soil conditions. The following table summarizes the peak ground and short and long period accelerations for a MCE event and incorporates a soil amplification factor for a Site Class D soil profile in the second column. Based on the site latitude and longitude (40.42952 degrees north and -111.91956 degrees west, respectively), the values for this site are tabulated on the following page.

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Spectral Acceleration Value, T Seconds	Site Class B-C Boundary [mapped values] (% g)	Site Class D [adjusted for site class effects] (% g)
Peak Ground Acceleration	45.2	47.4
0.2 Seconds, (Short Period Acceleration)	$S_S = 113.1$	$S_{MS} = 118.5$
1.0 Seconds (Long Period Acceleration)	$S_1 = 46.5$	$S_{M1} = 71.4$

The IBC 2006 code design accelerations (S_{DS} and S_{D1}) are based on multiplying the above accelerations (adjusted for site class effects) for the MCE event by two-thirds (⅔).

5.9.5 Liquefaction

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

Due to the lack of a shallow groundwater, the probability of liquefaction at the site during the design seismic event is considered low. Liquefaction potential will be evaluated during structure/site specific geotechnical analyses.

5.10 SITE OBSERVATIONS

As previously mentioned, collapsible soils appear to be present across much of the site to varying depths. Additionally, non-engineered fill was identified in isolated areas within the site. Therefore, we recommend that a qualified geotechnical engineer observe the building excavations to identify that all collapsible soils have been removed and that suitable soils have been completely encountered below the building footprint.

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We appreciate the opportunity of providing this service for you. If you have any questions or require additional information, please do not hesitate to contact us.

Respectfully submitted,

GSH Geotechnical Consultants, Inc. Reviewed by:

Alan D. Spilker, State of Utah No. 334228
Professional Engineer

Michael S. Huber, State of Utah No.343650
Professional Engineer

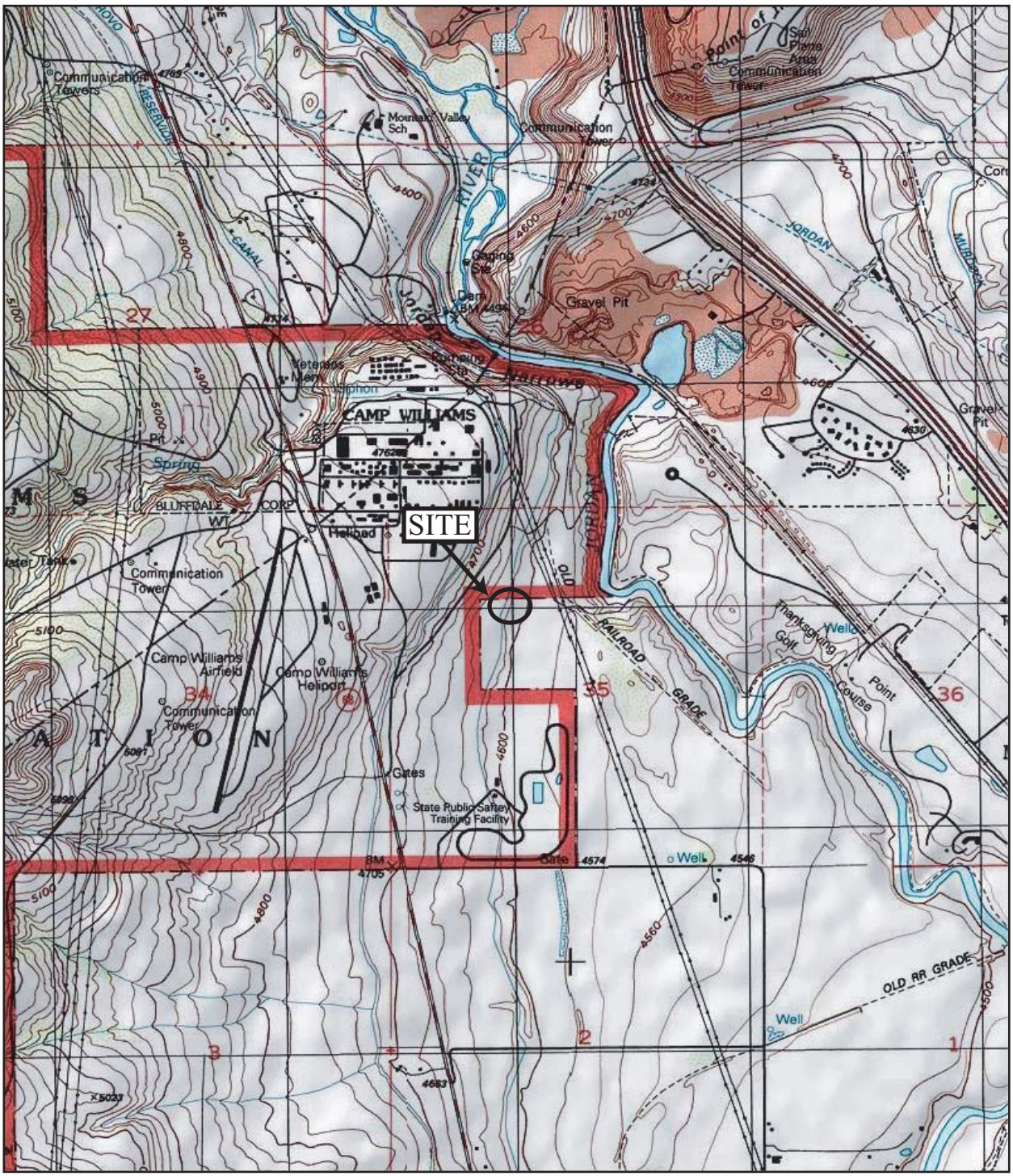
ADS/MSH:sn

Encl. Figure 1, Vicinity Map
Figure 2, Site Plan
Figure 3A through 3L, Log of Test pits
Figure 4, Unified Soil Classification System

Addressee (3)

draft

STATE OF UTAH-DFCM
JOB NO. 0128-008-07



SCALE IN FEET
1000 0 1000 2000

FIGURE 1
VICINITY MAP

REFERENCE:
USGS 7.5 MINUTE TOPOGRAPHIC QUADRANGLE MAP
TITLED "JORDAN NARROWS, UTAH"
DATED 1999

GSH
Gordon Spilker Huber
Geotechnical Consultants, Inc.

STATE OF UTAH-DFCM
JOB NO. 0128-008-07

NOT TO SCALE

FIGURE 2
SITE PLAN

REFERENCE:
ADAPTED FROM USGS AERIAL PHOTOGRAPH ENTITLED
"SANDY, UTAH", DATED SEPTEMBER 18, 2003
DOWNLOADED FROM TERRASERVER

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SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Project information.
2. Work covered by Contract Documents
3. Access to site.
4. Coordination with occupants.
5. Work restrictions.
6. Specification and drawing conventions.

1.3 PROJECT INFORMATION

A. Project Identification: PH II South Garrison Infrastructure. DFCM Project No. 13240480.

1. Project Location: Camp Williams, Utah.

B. Owner: State of Utah, Division of Facilities Construction and Management (DFCM).

1. Owner's Representative: Wayne Smith.

C. Architect: EFT Architects, Inc.

D. Architect's Consultants: The Architect has retained the following design professionals who have prepared designated portions of the Contract Documents:

1. Civil Engineer: Ensign.
2. Electrical Engineer: Ken Garner Engineering, Inc.

1.4 WORK COVERED BY CONTRACT DOCUMENTS

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

1. Site utilities, subgrade preparation, paving, curbs, gutters, and landscaping. Project includes alternates and unit prices.

B. Type of Contract:

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

1.5 ACCESS TO SITE

A. General: Contractor shall have limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.

B. Use of Site: Limit use of Project site to areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.

1. Driveways, Walkways and Entrances: Keep driveways and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.

a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

1.6 COORDINATION WITH OCCUPANTS

A. Full Owner Occupancy: Owner will occupy site and existing adjacent buildings during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's day-to-day operations. Maintain existing exits unless otherwise indicated.

1. Maintain access to existing walkways and other adjacent occupied or used facilities. Do not close or obstruct walkways or other occupied or used facilities without written permission from Owner and approval of authorities having jurisdiction.
2. Notify Owner not less than 72 hours in advance of activities that will affect Owner's operations.

B. Owner Limited Occupancy of Completed Areas of Construction: Owner reserves the right to occupy 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. Refer to General Conditions including Article “Partial Occupancy or Use.”

1.7 WORK RESTRICTIONS

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

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

B. On-Site Work Hours: Work shall be generally performed during normal business working hours of 7:00 a.m. to 5:00 p.m., Monday through Friday, unless otherwise indicated.

1. Weekend Hours: As approved by Owner.
2. Early Morning and Late Evening Hours: As approved by Owner.
3. Hours for Utility Shutdowns: As approved by Owner.

C. 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 Owner not less than two days in advance of proposed utility interruptions.
2. Obtain Owner's written permission before proceeding with utility interruptions.

D. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption to Owner occupancy with Owner.

1. Notify Owner not less than two days in advance of proposed disruptive operations.
2. Obtain Owner's written permission before proceeding with disruptive operations.

E. Nonsmoking Buildings: Smoking is not permitted within buildings or within 25 feet of entrance-ways, exits, operable windows, or air intakes.

F. Employee Identification: Contractor personnel working on Project site must have a current valid driver license, or other current valid government issued picture identification as approved by Owner, in possession at all times when on Project site.

1.8 SPECIFICATION AND DRAWING CONVENTIONS

A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications

1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

SECTION 012200 - UNIT PRICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

B. Related Requirements:

1. Section 012600 "Contract Modification Procedures" for procedures for submitting and handling Change Orders.

1.3 DEFINITIONS

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

1.4 PROCEDURES

A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.

B. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.

C. List of Unit Prices: A schedule of unit prices is included in Part 3.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF UNIT PRICES

A. Unit Price No. 1, Unit pricing for Patriot Way: Area limited to Patriot Way, south of the roundabout. Includes curbing, pavement, pavement striping and landscaping as shown on plans.

1. Description: Base bid includes all road grading, paving, grading, retention ponds, drainage and utility improvements shown on the plans. Excludes curbing, pavement, pavement striping, and landscaping in Patriot Way, south of the roundabout as shown on plans. Unit price No.1 is for a cost for a 1,600 linear foot section of finished road section as described above.
2. Unit of Measurement: 1,600 linear foot section.

END OF SECTION 012200

SECTION 012300 - ALTERNATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for alternates.

1.3 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 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 for each alternate is the net addition to the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.

1.4 PROCEDURES

A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.

1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.

B. 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. Refer to drawings and specifications for detailed information on Alternates.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

A. Base Bid:

1. Run new conduit and conductors shown on plans from Electrical House to lower garrison roundabout.
2. Install conduit for Teledata continuing from Officers Way to lower garrison roundabout.
3. Remove existing power pole in Patriot Way and add (2) power poles to support existing overhead conductors.
4. Install conduit for power to switch SG405 from SG501.
5. Install conduit for lighting from Officers Way to lower garrison roundabout switch GS503. Provide j-boxes in place of pole bases.
6. Demolish overhead conductors from SG502 northward.
7. Replace existing 4-way switch SG405 with a new 6-way switch.
8. Relocate existing 4-way switch SG405 to SG502 location.

B. Additive Alternate No. 1:

1. Install (1) 5" Conduit for future photovoltaic system in base bid ductbank from existing manhole east of MH-1 to SG501.
2. Stub out (2) 5” Conduits from SG501 to east side of Officers Way.

C. Additive Alternate No. 2:

1. Run power and telecom conduit from lower garrison roundabout to Mink Rd.
2. Install conduits for lighting from lower garrison roundabout to Mink Rd. Provide j-boxes in place of pole bases.
3. Install conductors for power from SG503 to SG504.
4. Demolish overhead power from SG502 to SG504.
5. Relocate existing 4-way switch SG405 to SG504.
6. Install conductors from new SG405 to SG501.

D. Additive Alternate No. 3:

1. Furnish and install pole lights and bases, and run conductors at lower garrison roundabout going north on Officers Way.

E. Additive Alternate No. 4:

1. Furnish and install pole lights and bases, and run conductors from lower garrison roundabout to Mink Road.

END OF SECTION 012300

SECTION 012500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for substitutions.

B. Related Requirements:

1. Section 012300 "Alternates" for products selected under an alternate.
2. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.3 DEFINITIONS

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

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

1.4 ACTION SUBMITTALS

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

1. Substitution Request Form: Use CSI Form 13.1A or equivalent.

   a. Provide PDF electronic files.

2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:

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

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

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

1.5 QUALITY ASSURANCE

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

1.6 PROCEDURES

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

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

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

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

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

B. Substitutions for Convenience: Architect will consider requests for substitution if received within 60 days after the Notice to Proceed. 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 012500

SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

B. Related Requirements:

1. Section 012500 "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.

1.3 MINOR CHANGES IN THE WORK

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

1.4 PROPOSAL REQUESTS

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

1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
2. Within time specified in Proposal Request, or within 15 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. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
   b. Include costs of labor and supervision directly attributable to the change.

c. 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.
d. Quotation Form: Use forms acceptable to Architect.

1) Provide PDF electronic files.

B. Contractor-Initiated Proposed Change Order (PCO): If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a Proposed Change Order for a change to Owner.

1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Comply with requirements in Section 012500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
7. Proposal Change Order Form: Form acceptable to Owner.

a. Provide PDF electronic files.

1.5 ADMINISTRATIVE CHANGE ORDERS

A. Unit-Price Adjustment: See Section 012200 "Unit Prices" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect measured scope of unit-price work.

1.6 CHANGE ORDER PROCEDURES

A. On Owner's approval of a Work Changes Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on Owner’s standard form.

1.7 CONSTRUCTION CHANGE DIRECTIVE

A. Construction Change Directive: Architect may issue a Construction Change Directive on Owner's standard form. 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 012600

SECTION 012900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

B. Related Requirements:
   1. Section 012200 "Unit Prices" for administrative requirements governing the use of unit prices.
   2. Section 012600 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
   3. Section 013200 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.

1.3 DEFINITIONS

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

1.4 SCHEDULE OF VALUES

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

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

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

2. Submit the schedule of values to Architect at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
3. Subschedules for Separate Elements of Work: Where the Contractor's construction schedule defines separate elements of the Work, provide subschedules showing values coordinated with each element.

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. 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.

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

1.5 APPLICATIONS FOR PAYMENT

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

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

B. Payment Application Times: The period for each progress payment is indicated in the Agreement between Owner and Contractor.

C. Application for Payment Forms: Owner’s standard form.

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.

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.

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

G. 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. Products list (preliminary if not final).
5. Schedule of unit prices.
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.

H. 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.

I. 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. Contractor's affidavit of payment.
2. Insurance certificate for insurance to remain in force.
3. Contractor's written statement for insurance renewal.
4. Consent of Surety for Final Payment, if required.
5. Record Documents, warranties, instructions, operation and maintenance manuals, training videos.
6. Data establishing payment or satisfaction of obligations, such as receipts, releases and waivers of liens, claims, security interests or encumbrances.
7. Contractor's written statement on distribution of earned interest on retention to Subcontractors.
8. Submit the following Owner's standard Final Payment forms as required by Owner:

    a. "Contractor's Affidavit of Payment."
    b. "Contractor's Commitment to Insurance."
    c. "Consent of Surety to Final Payment."
    d. "Contractors Commitment to Distribute Interest on Retention."
    e. "Project Closeout Checklist."

9. Evidence of completion of Project closeout requirements.
10. Updated final statement, accounting for final changes to the Contract Sum.
11. Final meter readings for utilities, a measured record of stored fuel if any, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
12. Final liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:

1. General coordination procedures.
2. Coordination drawings.
3. Requests for Information (RFIs).
4. Project meetings.

B. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.

C. Related Requirements:

1. Section 013200 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
2. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services.
3. Section 017700 "Closeout Procedures" for coordinating closeout of the Contract.

1.3 DEFINITIONS

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

1.4 INFORMATIONAL SUBMITTALS

A. Subcontract List: Owner’s standard form.

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.

1.5 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. 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.

C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities 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.

D. 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.

1.6 REQUESTS FOR INFORMATION (RFIs)

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, and details of affected materials, on attached sketches.

C. RFI Forms: Owner’s standard form.

1. Provide PDF electronic files.

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 Section 012600 "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 and maintain a tabular log of RFIs organized by the RFI number. 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.

1.7 PROJECT MEETINGS

A. General: Meetings and conferences will be held at Project site unless otherwise indicated.

1. Attendees: Inform Contractor’s participants and individuals whose presence is required, of date and time of each meeting.
2. Agenda: Prepared by Architect. Distribute the agenda to all invited attendees.
3. Minutes: Architect will record and distribute meeting minutes.

B. Preconstruction Conference: Owner will schedule and conduct a preconstruction conference before starting construction. Conference will be held at Project site or

another location. Meeting will be conducted to review responsibilities and personnel assignments.

1. Minutes: Architect will record and distribute 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. Possible conflicts.
    i. Compatibility requirements.
    j. Time schedules.
    k. Weather limitations.
    l. Manufacturer's written instructions.
    m. Warranty requirements.
    n. Compatibility of materials.
    o. Acceptability of substrates.
    p. Temporary facilities and controls.
    q. Space and access limitations.
    r. Regulations of authorities having jurisdiction.
    s. Testing and inspecting requirements.
    t. Installation procedures.
    u. Coordination with other work.
    v. Required performance results.
    w. Protection of adjacent work.
    x. 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: Architect will schedule and conduct a project closeout conference not later than 30 days prior to the scheduled date of Substantial Completion.

1. The conference is 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: 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. Preparation of Contractor's punch list.
    f. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
    g. Submittal procedures.
    h. Coordination of separate contracts.
    i. Owner's partial occupancy requirements.
    j. Responsibility for removing temporary facilities and controls.

4. Minutes: Architect will record and distribute meeting minutes.

E. Progress Meetings: Architect will generally conduct progress meetings at weekly intervals, unless other interval is established.

1. Attendees: In addition to representatives of Owner, 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.
2. 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) Status of submittals.
3) Deliveries.
4) Off-site fabrication.
5) Access.
6) Site utilization.
7) Temporary facilities and controls.
8) Progress cleaning.
9) Quality and work standards.
10) Status of correction of deficient items.
11) Field observations.
12) Status of RFIs.
13) Status of proposal requests.
14) Pending changes.
15) Status of Change Orders.
16) Pending claims and disputes.
17) Documentation of information for payment requests.
18) Status of record documents.

3. Minutes: Architect 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 013100

SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1. Contractor's construction schedule.
2. Daily construction reports.
3. Material location reports.
4. Site condition reports.
5. Special reports.

B. Related Requirements:

1. Section 013300 "Submittal Procedures" for submitting schedules and reports.
2. Section 014000 "Quality Requirements" for submitting a schedule of tests and inspections.

1.3 INFORMATIONAL SUBMITTALS

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

1. PDF electronic file.

B. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period. Refer to General Conditions including Article “Time and Construction Schedules” for requirements.

C. Daily Construction Reports: Submit at weekly intervals.

D. Material Location Reports: Submit at weekly intervals.

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

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

G. Qualification Data: For scheduling specialist.

1.4 QUALITY ASSURANCE

A. Scheduling Specialist Qualifications: An experienced specialist in CPM scheduling and reporting.

1.5 COORDINATION

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

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

PART 2 - PRODUCTS

2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE (CPM SCHEDULE)

A. General: Refer to General Conditions including Article “Time and Contractor’s Construction Schedules” for requirements.

2.2 REPORTS

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

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

17. Equipment or system tests and startups.
18. Partial completions and occupancies.
19. Substantial Completions authorized.

B. Material Location Reports: At weekly intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site. Indicate the following categories for stored materials:

1. Material stored prior to previous report and remaining in storage.
2. Material stored prior to previous report and since removed from storage and installed.
3. Material stored following previous report and remaining in storage.
4. Provide critical path schedule for materials and equipment which is coordinated with the Contractor's Construction Schedule.

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

2.3 SPECIAL REPORTS

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

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

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Contractor's Construction Schedule Updating, Changes, Modifications, and Recovery: Refer to General Conditions including Article "Time and Contractor's Construction Schedules."

END OF SECTION 013200

SECTION 013233 - PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1. Preconstruction digital images.
2. Periodic construction digital images.

1.3 INFORMATIONAL SUBMITTALS

A. Digital Images: Submit image files within three days of taking digital images.

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 digital image.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 CONSTRUCTION DIGITAL IMAGES

A. General: Take digital images using the maximum range of depth of field, and that are in focus, to clearly show the Work. Digital images with blurry or out-of-focus areas will not be accepted.

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 Digital Images: Before starting construction and demolition, take digital images of Project site and surrounding properties, including existing items to remain during construction, from different vantage points.

1. Flag construction limits before taking construction digital images.
2. Take minimum 20 digital images to show existing conditions adjacent to property before starting the Work.
3. Take minimum 20 digital images of existing buildings either on or adjoining property to accurately record physical conditions at start of construction.
4. Take additional digital images as required to record settlement or cracking of adjacent structures, pavements, and improvements.

D. Periodic Construction Digital Images: Take minimum 20 digital images 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 digital images were taken.

END OF SECTION 013233

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

B. Related Requirements:

1. Section 012900 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
2. Section 013200 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
3. Section 017823 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
4. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.

1.3 DEFINITIONS

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

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

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

1.4 ACTION SUBMITTALS

A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections. Refer to General Conditions including Article “Time and Contractor’s Construction Schedules” for additional requirements.

1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
2. 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.

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

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

1.5 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

A. Architect's Digital Data Files: Electronic digital data files of the Contract Drawings will not be provided by Architect for Contractor's use in preparing submittals.

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.

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

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

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

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

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

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

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

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

E. Options: Identify options requiring selection by Architect.

F. 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.

G. Resubmittals: Make resubmittals in same form 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 "No Exception Taken" or "Note Marked Exceptions."

H. 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.

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

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

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

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

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

2. 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.

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

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

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

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

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

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

a. PDF electronic file.

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

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

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

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

a. PDF electronic file.

D. 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. Submit product schedule in the following format:

a. PDF electronic file.

E. Contractor's Construction Schedule: Comply with requirements specified in Section 013200 "Construction Progress Documentation."

F. Application for Payment and Schedule of Values: Comply with requirements specified in Section 012900 "Payment Procedures."

G. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Section 014000 "Quality Requirements."

H. Closeout Submittals: Comply with requirements specified in Section 017700 "Closeout Procedures."

I. Maintenance Data: Comply with requirements specified in Section 017823 "Operation and Maintenance Data."

J. 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.

K. 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.

L. 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.

M. 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.

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

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

P. 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.

Q. 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.

R. 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.

S. 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.

T. 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.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

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

B. Project Closeout and Maintenance Material Submittals: See requirements in Section 017700 "Closeout Procedures."

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

3.2 ARCHITECT'S ACTION

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

1. Final Unrestricted Release: Where the submittal is marked "No Exceptions Taken," the Work covered by the submittal may proceed provided it complies with the Contract Documents. Final acceptance will depend on that compliance.
2. Final-but-Restricted Release: Where the submittal is marked "Note Marked Exceptions," the Work covered by the submittal may proceed provided it complies both with Architect's notations and corrections on the submittal and the Contract Documents. Final acceptance will depend on that compliance.
3. Returned for Resubmittal: Where the submittal is marked "Revise and Resubmit," do not proceed with the Work covered by the submittal, including purchasing, fabrication, delivery, or other activity for the product submitted. Revise or prepare a new submittal according to Architect's notations and corrections.
4. Rejected: Where the submittal is marked "Rejected," do not proceed with the Work covered by the submittal. Prepare a new submittal for a product that complies with the Contract Documents.

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. When use of partial submittals is not approved, partial submittals will be considered as incomplete submittals.

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 013300

SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

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

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

1.3 DEFINITIONS

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

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

C. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.

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

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

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

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

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

1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).

I. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.4 CONFLICTING REQUIREMENTS

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

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

1.5 ACTION SUBMITTALS

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

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

1.6 INFORMATIONAL SUBMITTALS

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

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

C. Contractor's Statement of Responsibility: Submit copy of written statement of responsibility sent to authorities having jurisdiction for systems or components requiring special tests or inspections.

1. Refer to drawings for additional requirements.

D. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

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

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

1.7 CONTRACTOR'S QUALITY-CONTROL PLAN

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

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

1. Project superintendent may also serve as quality-control manager.

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

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

1. Contractor-performed tests and inspections including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections.
2. Special inspections required by authorities having jurisdiction and indicated on the "Special Inspection and Testing Items" form on drawings.
3. Owner-performed tests and inspections indicated in the Contract Documents, including tests and inspections indicated to be performed by the Commissioning Authority.

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

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

1.8 REPORTS AND DOCUMENTS

A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, and telephone number of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

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

1.9 QUALITY ASSURANCE

A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated for this Project.

F. Specialists: Certain Specification Sections may require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.

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

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

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

H. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:

1. Contractor responsibilities include the following:

   a. Provide test specimens representative of proposed products and construction.
   b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
   c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
   d. Build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.
   e. When testing is complete, remove test specimens, assemblies, and mockups; do not reuse products on Project.

2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect and Commissioning Authority, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

1.10 QUALITY CONTROL

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

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

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

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

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

3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
5. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

D. Testing Agency Responsibilities: Cooperate with Architect, Commissioning Authority and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.

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

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

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

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

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

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

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

1.11 SPECIAL TESTS AND INSPECTIONS

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

1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviews the completeness and adequacy of those procedures to perform the Work.
2. Notifying Architect, Commissioning Authority, and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect and Commissioning Authority with copy to Contractor and to authorities having jurisdiction.
4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
6. Retesting and reinspecting corrected work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:

1. Date test or inspection was conducted.
2. Description of the Work tested or inspected.
3. Date test or inspection results were transmitted to Architect.
4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's, Commissioning Authority's, reference during normal working hours.

3.2 REPAIR AND PROTECTION

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

1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000

SECTION 014200 - REFERENCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 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.

1.3 INDUSTRY STANDARDS

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

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

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

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

1.4 ABBREVIATIONS AND ACRONYMS

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 014200

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

B. Related Requirements:

1. Section 011000 "Summary" for work restrictions and limitations on utility interruptions.

1.3 USE CHARGES

A. General: Installation and removal of temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, Architect, occupants of Project, testing agencies, and authorities having jurisdiction.

B. Water Service from Existing System: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

C. Electric Power Service from Existing System: Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

1.4 INFORMATIONAL SUBMITTALS

A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.

B. Erosion- and Sedimentation-Control Plan: Show compliance with requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.

C. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.

D. Moisture-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage.

1. Describe delivery, handling, and storage provisions for materials subject to water absorption or water damage.
2. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water-damaged Work.
3. Indicate sequencing of work that requires water and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.

1.5 QUALITY ASSURANCE

A. 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.

1.6 PROJECT CONDITIONS

A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to 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.

PART 2 - PRODUCTS

2.1 TEMPORARY FACILITIES

A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.

B. 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 15 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 4-foot- square tack and marker boards.

3. Drinking water and private toilet.
4. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F.
5. Lighting fixtures capable of maintaining average illumination of 20 fc at desk height.

C. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.

1. Store combustible materials apart from building.

2.2 EQUIPMENT

A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

PART 3 - EXECUTION

3.1 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 by progress of the Work.

B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

A. General: Install temporary service or connect to existing service

1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.

B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.

1. Connect temporary sewers to existing system as directed by authorities having jurisdiction.

C. Water Service: Connect to Owner's existing water service facilities. Clean and maintain water service facilities in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.

D. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

E. Electric Power Service: Connect to Owner's existing electric power service. Maintain equipment in a condition acceptable to Owner.

1. Connect temporary service to Owner's existing power source, as directed by Owner.

F. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.

G. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install one telephone line for each field office.

1. At each telephone, post a list of important telephone numbers.

a. Police and fire departments.
b. Ambulance service.
c. Contractor's home office.
d. Contractor's emergency after-hours telephone number.
e. Architect's office.
f. Engineers' offices.
g. Owner's office.
h. Principal subcontractors' field and home offices.

2. Provide superintendent with cellular telephone for use when away from field office.

H. Electronic Communication Service: Provide a desktop computer in the primary field office adequate for use by Architect and Owner to access Project electronic documents and maintain electronic communications. Equip computer with not less than the following:

1. Display: Minimum 22-inch LCD monitor.
2. Full-size keyboard and mouse.
3. Printer: "All-in-one" unit equipped with printer server, combining color printing, photocopying, scanning, and faxing, or separate units for each of these three functions.
4. Internet Service: Broadband modem, router and ISP, equipped with hardware firewall.
5. Internet Security: Integrated software, providing software firewall, virus, spyware, phishing, and spam protection in a combined application.
6. Backup: External hard drive with automated backup software providing daily backups.

3.3 SUPPORT FACILITIES INSTALLATION

A. General: Comply with the following:

1. Provide construction for temporary offices, shops, and sheds located within construction area or within 30 feet of building lines that is noncombustible according to ASTM E 136. Comply with NFPA 241.
2. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

B. Traffic Controls: Comply with requirements of authorities having jurisdiction.

1. Protect existing site improvements to remain including curbs, pavement, and utilities.
2. Maintain access for fire-fighting equipment and access to fire hydrants.

C. Parking: Coordinate availability, access, size, location, and usage requirements of parking areas for construction personnel with Owner.

D. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. 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 properties or endanger permanent Work or temporary facilities.
2. Remove snow and ice as required to minimize accumulations.

E. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.

1. Identification Signs: Provide Project identification signs as follows:

a. Engage an experienced sign painter to apply graphics for Project identification signs. Furnish details and proposed location for approval of Owner and Architect. Sign is to contain the following:

1) Name of project.
2) DFCM as Owner for the State of Utah.
3) Architect.
4) Architect's consultants.
5) Contractor.
6) Mechanical subcontractor.
7) Electrical subcontractor.
8) Rendering (electronic image file provided by Architect).

b. Sign size: 4 feet by 8 feet minimum.
c. 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.

d. Paint sign panel and applied graphics with exterior-grade gloss enamel over exterior primer.

2. Provide temporary, directional signs for construction personnel and visitors.
3. Maintain and touchup signs so they are legible at all times
4. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.

   a. Provide temporary, directional signs for construction personnel and visitors.

5. Maintain and touchup signs so they are legible at all times.

F. Waste Disposal Facilities: Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."

G. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.

1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.

B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

1. Comply with work restrictions specified in Section 011000 "Summary."

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 requirements of 2003 EPA Construction General Permit or 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 damage from construction operations. Protect tree root systems from damage, flooding, and erosion.

F. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

G. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities.

H. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.
   1. Develop and supervise an overall fire-prevention and -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.

3.5 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.

C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.

D. 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 property of Contractor.

END OF SECTION 015000

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.

B. Related Requirements:

1. Section 012300 "Alternates" for products selected under an alternate.
2. Section 012500 "Substitution Procedures" for requests for substitutions.
3. Section 014200 "References" for applicable industry standards for products specified.

1.3 DEFINITIONS

A. Products: Items obtained 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. Products salvaged or recycled from other projects are not considered new products.
3. Comparable Product: Product that is demonstrated and approved through submittal process 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. Basis-of-Design Product Specification: A specification in which a specific manufacturer's product is named and accompanied by the words "basis-of-design product," 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 additional manufacturers named in the specification.

1.4 ACTION SUBMITTALS

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

1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Architect will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

a. Form of Approval: As specified in Section 013300 "Submittal Procedures."
b. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.

B. Basis-of-Design Product Specification Submittal: Comply with requirements in Section 013300 "Submittal Procedures." Show compliance with requirements.

1.5 INFORMATIONAL SUBMITTALS

A. List of Warranties: Submit list of warranties required within the individual Sections.

1.6 QUALITY ASSURANCE

A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.

1.7 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.

B. Delivery and Handling:

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 determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.

C. Storage:

1. Store products to allow for inspection and measurement of quantity or counting of units.
2. Store materials in a manner that will not endanger Project structure.
3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
6. Protect stored products from damage and liquids from freezing.
7. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces, if any. Coordinate location with Owner.

1.8 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.

1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
3. See other Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Section 017700 "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, 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. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
6. Or Equal: For products specified by name and accompanied by the term "or equal," or "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.

B. Product Selection Procedures:

1. Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
3. Products:

   a. Nonrestricted List: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product.

4. Manufacturers:

   a. Nonrestricted List: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer, that complies with requirements.

Comply with requirements in "Comparable Products" Article for consideration of an unnamed manufacturer's product.

5. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated 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 requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.

C. Visual Matching Specification: Where Specifications require "match Architect's sample", provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.

1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 012500 "Substitution Procedures" for proposal of product.

D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 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 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 016000

SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1. Construction layout.
2. Field engineering and surveying.
3. Installation of the Work.
4. Cutting and patching.
5. Progress cleaning.
6. Protection of installed construction.

B. Related Requirements:

1. Section 011000 "Summary" for limits on use of Project site.
2. Section 017700 "Closeout Procedures" for final cleaning.

1.3 DEFINITIONS

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

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

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For land surveyor or professional engineer.

B. Certificates: Submit certificate signed by land surveyor or professional engineer 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. Products: List products to be used for patching and firms or entities that will perform patching work.
3. Dates: Indicate when cutting and patching will be performed.
4. Utilities: List services and systems that cutting and patching procedures will disturb or affect. List services and systems that will be relocated and those that will be temporarily out of service. Indicate length of time permanent services and systems will be disrupted.

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

1.5 QUALITY ASSURANCE

A. Land Surveyor and Professional Engineer Qualifications: A professional land surveyor or engineer 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. Other Construction Elements: Do not cut and patch other construction elements or 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
2. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. 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.

PART 2 - PRODUCTS

2.1 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

3.1 EXAMINATION

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

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

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

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

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

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

3.2 PREPARATION

A. Existing Utility Information: Furnish information to local utility that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

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

C. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect according to requirements in Section 013100 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

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

B. General: Engage a land surveyor or professional engineer 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.

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

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

3.4 FIELD ENGINEERING

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

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

1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.

2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

3.5 INSTALLATION

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

1. Make vertical work plumb and make horizontal work level.

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. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect.

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

3.6 CUTTING AND PATCHING

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

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

C. 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.

D. Existing Utility Services: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.

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.

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. Concrete: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
3. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
4. 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.

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

3.7 PROGRESS CLEANING

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

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

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

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

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

C. 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.

D. 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 Section 017419 "Construction Waste Management and Disposal."

E. During handling and installation, clean and protect construction in progress and adjoining materials already in place.

F. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period.

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

3.8 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.

END OF SECTION 017300

SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1. Disposing of nonhazardous demolition and construction waste.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 RECYCLING WASTE, GENERAL

A. General: Recycle paper and beverage containers used by on-site workers.

B. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.

3.2 DISPOSAL OF WASTE

A. General: Remove waste materials from Project site and legally dispose of them in a landfill acceptable to authorities having jurisdiction.

B. Burning: Do not burn waste materials.

C. Disposal: Remove waste materials from Owner's property and legally dispose of them.

END OF SECTION 017419

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

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

B. Related Requirements:

1. Section 017300 "Execution" for progress cleaning of Project site.
2. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.
3. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.

1.3 ACTION SUBMITTALS

A. Contractor's Punchlist: Submittal at Substantial Completion.

1.4 CLOSEOUT SUBMITTALS

A. Certificates of Release: From authorities having jurisdiction.

1.5 SUBSTANTIAL COMPLETION PROCEDURES

A. Refer to General Conditions including Article “Substantial Completion Inspection” for requirements related to Substantial Completion.

B. Contractor's Punchlist: Prepare and submit a list of items to be completed and corrected, indicating the value of each item on the list and reasons why the Work is incomplete.

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

1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
2. Submit closeout submittals specified in other Division 01 Sections, including project record documents, and operation and maintenance manuals.
3. Submit closeout submittals specified in individual Sections, including specific warranties, final certifications, and similar documents.
4. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

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

1. Advise Owner of pending insurance changeover requirements.
2. Terminate and remove temporary facilities from Project sites.
3. Complete final cleaning requirements.
4. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
5. 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. Refer to General Conditions including Article “Substantial Completion Inspection” for additional requirements.

1.6 FINAL COMPLETION PROCEDURES

A. Refer to General Conditions including Article “Final Completion Inspection” for requirements related to Final Completion.

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

1. Submit a final Application for Payment according to Section 012900 "Payment Procedures."
2. Punchlist Verification: Verify completion of punchlist items and state that each item on punchlist has been corrected, completed, or otherwise resolved for acceptance.
3. 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. Refer to General Conditions including Article “Final Completion Inspection” for additional requirements.

1.7 CONTRACTOR’S PUNCHLIST

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 in sequential order.
2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
3. Include the following information at the top of each page:

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

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

a. PDF electronic file. Architect will return annotated file.

1.8 SUBMITTAL OF PROJECT WARRANTIES

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

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

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

1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.

4. Warranty Electronic File: Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

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

PART 2 - PRODUCTS

2.1 MATERIALS

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

PART 3 - EXECUTION

3.1 FINAL CLEANING

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

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial 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. Remove tools, construction equipment, machinery, and surplus material from Project site.
d. Leave Project clean and ready for occupancy.

C. Construction Waste Disposal: Comply with waste disposal requirements in Section 017419 "Construction Waste Management and Disposal."

3.2 REPAIR OF THE WORK

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

B. Repair or remove and replace defective construction. Where damaged items cannot be repaired or restored, provide replacements. Restore damaged construction to specified condition.

END OF SECTION 017700

SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:

1. Operation manuals for systems.
2. Product maintenance manuals.

B. Related Requirements:

1. Section 013300 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.

1.3 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. 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 formats:

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.

C. Manual Submittal: Submit each manual in final form, in PDF electronic file format only, prior to requesting inspection for Substantial Completion and before commencing demonstration and training. Architect and Commissioning Authority will return electronic file with comments within 15 days.

1. Correct or revise each manual to comply with Architect's and Commissioning Authority's comments.
2. Submit 3 paper copies and 3 compact discs in PDF electronic file format of each corrected manual within 15 days of receipt of Architect's and Commissioning Authority's comments and prior to requesting Substantial Completion and commencing demonstration and training.

PART 2 - PRODUCTS

2.1 REQUIREMENTS FOR OPERATION, AND MAINTENANCE MANUALS

A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system. Each manual shall contain the following materials, in the order listed:

1. Title page.
2. Table of contents.
3. 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 Architect.
7. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
8. 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.

D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system. If possible, assemble instructions into a single binder.

E. 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 names used in manual directory and table of contents. Group documents for each system into

individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

F. Manuals, Paper Copy: Submit manuals in the form of hard copy, bound and labeled volumes.

1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf or post-type 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 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 oversize 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.

2.2 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 descriptions. Use designations for systems indicated on Contract Documents.
2. Operating standards.
3. Operating procedures.
4. Wiring diagrams.
5. Piped system diagrams.

6. Precautions against improper use.

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. Engineering data and tests.
8. Complete nomenclature and number of replacement parts.

C. Operating Procedures: Include the following, as applicable:

1. Special operating instructions and procedures.

2.3 PRODUCT MAINTENANCE MANUALS

A. Content: Organize manual into a separate section for each product and material. 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. Material and chemical composition.
4. Reordering information for specially manufactured products.

D. Maintenance Procedures: Include manufacturer's written recommendations and the following:

1. Inspection procedures.
2. Repair instructions.

E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

A. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system.

B. 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.

C. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 017823

SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

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

B. Related Requirements:

1. Section 017700 "Closeout Procedures" for general closeout procedures.
2. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.3 CLOSEOUT SUBMITTALS

A. Record Drawings: Comply with the following:

1. Number of Copies: Submit copies of record Drawings as follows:

a. Final Submittal:

1) Submit one paper-copy set 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 record Specifications as paper copy and scanned PDF electronic file(s) of marked-up paper copy of Specifications.

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

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

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

PART 2 - PRODUCTS

2.1 RECORD DOCUMENTS

A. Refer to General Conditions including Article “Documents and Samples at the Site, Certifying “As-Builts”” for requirements related to record documents including signing and certification of record documents.

2.2 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. 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.

C. 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. Identification: As follows:

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

2.3 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.

2.4 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. Submit record Product Data as annotated PDF electronic files.

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

2.5 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. Miscellaneous record submittals include Samples.

B. Submit miscellaneous record submittals as PDF electronic file.

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

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

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

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

END OF SECTION 017839

DIVISION 02

EXISTING CONDITIONS

AMERICAN PUBLIC WORKS ASSOCIATION TECHNICAL SPECIFICATIONS

INCLUSION DOCUMENT

The Technical Specification and Standard Plan Document that shall govern the Civil (provided by Ensign Engineering) portion of Project are listed below:

American Public Works (APWA)
Manual of Standard Specifications and Manual of Standard Plans 2012 Edition

The American Public Works Association (APWA), Manual of Standard Specifications and Standard Plans (2012 Edition) Documents shall govern this Project as if they were printed and included in their entirety in the Project Manual. They are made a part of this Project by this reference.

The Divisions listed below are the Divisions which apply to this Project [All references to Divisions 00 and 01 (Contracting and General Requirements) shall follow the Project Manual **not** APWA]. Applicable sections for this project have been provided in these contract documents; however, they are not complete. It is the Contractors responsibility to obtain the entire set of specifications from the resource listed at the bottom of this page and use those specifications in the preparation of their bid and throughout the construction of this project.

DIVISION 02 – EXISTING CONDITIONS
DIVISION 03 – CONCRETE
DIVISION 31 – EARTHWORK
DIVISION 32 – EXTERIOR IMPROVEMENTS
DIVISION 33 – UTILITIES

The APWA Manual of Standard Specifications and Plans should be used in the preparation of the Bid for this Project. It is the Bidders responsibility to utilize these Documents and to know and understand them as they apply to this Project and to include in their Bid any costs associated with complying with the provisions provided therein.

It shall be required that these Documents be on site at all times during Construction.

The APWA Manual is available at the following locations which are listed below:

- **For Purchase at:**
  Utah LTAP Center
  Utah State University
  8205 Old Main Hill
  Logan, Utah 84322-8205
  Phone Number (800) 822-8878 or (435) 797-2931

(End Document)

SECTION 02 41 13
SELECTIVE SITE DEMOLITION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Remove site structural and site utility items and dispose of them off site.

B. Salvage.

1.2 PAYMENT PROCEDURES

A. Payment for structures or obstructions that are not designated for removal and disposal in the Bid documents, that cannot be removed with equipment reasonably expected to be used in the work without cutting, drilling, or blasting, will be paid for **by Change Order**.

B. Backfilling depressions left because of demolition work will not be measured or paid for separately except as provided in the preceding paragraph.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION

3.1 PREPARATION

A. Review all work procedures with ENGINEER and with representatives of any utility in the work zone.

B. Locate and preserve all active utilities which are to remain in service.

C. Implement the traffic control plan requirements, Section 01 55 26.

3.2 PROTECTION

A. Protect irrigation systems.

B. Protect structures to be removed and their contents from vandalism and theft.

C. Protect trees:

1. Avoid or minimize damage to trees and tree roots.
2. Provide certified arborist observation of root cuts larger than four (4) inches diameter. Roots provide anchorage, storage of energy, and absorption and conduction of water and mineral elements. Loss of root connection affects health and stability of tree and safety of people and property. Notify ENGINEER of such root cut.

D. Repair or replace damage at no additional cost to OWNER.

3.2 **STRUCTURE DEMOLITION**

A. Remove structures and incidentals such as foundations, fences, outbuildings, etc.

B. Remove foundation walls at least two (2) feet below finished grade or two (2) feet below natural ground surface. Remove floor slab or break it into pieces no larger than three (3) feet square.

C. Backfilling and compaction of excavations for structures, Section 31 23 23.

D. Building components, Section 02 41 19.

3.3 **PIPELINE DEMOLITION**

A. General:

1. Abandoned pipelines not to be salvaged are considered as incidental excavation work, Section 31 23 16.
2. Do not damage pipe or structures that remain in service or are to be salvaged for OWNER.

B. Gravity Pipe Demolition:

1. Plug abandoned pipe with a permanent, water-tight concrete plug extending into the abandoned pipe at least two (2) feet.
2. Seal openings in walls of remaining manholes, catch basins, or structures with water-tight plugs.

C. Pressure Pipe Demolition:

1. Coordinate demolition with ENGINEER and agency owning the utility pipe.
2. Plug abandoned pipe with a permanent water-tight plug.
3. Cap and restrain the active pipe with a blind flange or equivalent type of plug.
4. For service line demolition or abandonment, disconnect the line from the mainline and shut off the corporation stop.

3.4 **BRIDGE AND ABUTMENT DEMOLITION**

A. Remove existing bridges and abutments indicated.

B. Remove structures so that no remaining portion is closer than three (3) feet to any water course or closer than two (2) feet to the Subgrade and Embankment surface, or within two (2) feet of the natural ground surface.

C. Remove structures so compacted backfill can be provided as required in backfilling operation, Section 31 23 23.

3.5 **BURIED FUEL TANK DEMOLITION**

A. Remove buried fuel storage tanks and dispose of tank contents in accordance with Laws and Regulations.

B. Do not spill fuel on Subgrade.

C. Comply with the local authority having jurisdiction over fuel tank

removals.

3.6 MISCELLANEOUS DEMOLITION

A. Remove miscellaneous structures and obstructions or cover them with backfill if the result meets the following requirements:

1. Backfill is stable.
2. Burial does not interfere with construction.
3. Permission to do so is obtained from ENGINEER.
4. No remaining portion is within two (2) feet of the final ground surface contours.

3.7 SALVAGE

A. Salvage designated equipment and materials for OWNER.

B. All other material becomes the property of CONTRACTOR unless such materials are not owned by OWNER.

END OF SECTION

SECTION 02 41 14
PAVEMENT REMOVAL

PART 1 GENERAL

1.1. **SECTION INCLUDES**

A. Remove roadway Pavement.

B. Remove curb, gutter, sidewalk, Driveway Approach, waterway and similar flat work.

1.2 **MEASUREMENT PROCEDURES**

A. Double saw cutting required for pavement removal or T-patches will not be measured or paid for separately.

1.3 **SUBMITTALS**

A. Traffic control plan, Section 01 55 26.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 **PREPARATION**

A. Implement the traffic control plan requirements.

B. Coordinate utility locations, Section 01 31 13.

C. Preserve all active utilities.

D. Notify neighborhood at least 48 hours before day and time of operation.

E. Mark existing utilities on redline drawings.

3.2 **PROTECTION**

A. Install Invert Covers, Section 01 71 13.

B. Trees:

1. Avoid or minimize damage to trees and tree roots.
2. Provide certified arborist observation of root cuts larger than four (4) inches diameter. Roots provide anchorage, storage of energy, and absorption and conduction of water and mineral elements. Loss of root connection affects health and stability of tree and safety of people and property. Notify ENGINEER of such root cut.

C. Existing Surfaces:

1. Protect adjacent surfaces including concrete walls, planters, carriage walks, driveway approaches, rock walls, rock gardents concrete

steps, sidewalks, and curb cut assemblies. Replace damaged facilities at no additional cost to OWNER.

2. Use rubber cleats or Pavement pads when operating backhoes, outriggers, track equipment, or any other equipment on or crossing paved surfaces.
3. Restore paved surfaces that are damaged by removal operations at no additional cost to the OWNER. Match the existing Pavement surface plus 1 inch.

D. Environment:

1. Control dust, Section 01 57 00.
2. Protect plant and animal habitat. Follow federal, state or local protection requirements.

E. Repair or replace any damage at no additional cost to OWNER.

3.3 REMOVE PORTLAND CEMENT CONCRETE PAVEMENT

A. Cutting:

1. DO NOT use machine mounted impact hammers.
2. Make concrete cuts straight, vertical, true, full-depth.
3. Cut along perimeter of panel to be removed. Where edge of existing surface is cracked, broken, or deteriorated, make the cut so the defective surface can be removed.
4. Cut along any edge that is damaged during construction, including cavities underneath caused by construction or concrete removal.

B. Removal:

1. Remove concrete to the nearest expansion joint or vertical saw cut.
2. Remove panels without damaging remaining panels.
3. Remove all bonding inhibitors.

3.4 REMOVE ASPHALT CONCRETE PAVEMENT

A. Cutting:

1. Use any method that produces a true, vertical, full-depth cut.
2. When asphalt concrete overlays Portland cement concrete Pavement, DO NOT use machine mounted impact hammers.
3. If an edge of an existing surface is cracked, broken, or deteriorated, make the cut so the defective surface can be removed.
4. Re-cut along any edge that is damaged during construction, and where cavities underneath pavement are caused by construction.

B. Removal: Remove asphalt pavement without damaging remaining.

3.5 REMOVE CONCRETE FLAT WORK

A. Saw cut flat work at weakened plane joints. Saw cut full depth.

B. Where edge of existing surface is cracked, broken, or deteriorated, make the cut so the defective surface can be removed.

C. Saw along any edge that is damaged during construction, including

cavities underneath caused by construction.

D. If flat work that is not scheduled for removal is damaged, remove and replace the flat work at no additional cost to OWNER.

3.6 **CLEANING**

A. Remove all debris and dust. Clean surrounding rails, sidewalks, Driveways, Driveway approaches, landscaping, concrete flat work, and other objects in vicinity of work.

END OF SECTION

SECTION 02 41 15
CURB AND TRIP HAZARD REMOVAL

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Saw cut and remove a curb.

B. Remove a trip hazard by saw cutting, grinding, or jacking.

1.2 **REFERENCES**

A. **APWA Standards**:

Plan 222: Saw cut driveway approach.

Plan 235: Corner curb cut assembly.

Plan 236: Tangent curb cut assembly.

Plan 237: Island and median.

1.3 **SUBMITTALS**

A. Traffic control plan, Section 01 55 26.

1.4 **SITE CONDITIONS**

A. Control dust, Section 01 57 00.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 **PROTECTION**

A. Implement the traffic control plan requirements.

B. Do not damage abutting surfaces that are not scheduled for cutting or removal.

C. Protect plant and animal habitat. Follow federal, state or local protection requirements.

3.2 **CURB REMOVAL FOR NEW DRIVEWAY APPROACH**

A. Reference: APWA Plan 222.

B. Apron: Saw off curb so surface of curb cut matches slope of apron. No lip at flow-line unless indicated elsewhere.

C. Curb Flare: Saw off curb perpendicular to the back of curb:

1. If the flare is in a pedestrian walking area, limit the curb cut slope (parallel to the flow-line) to 10 percent (1:10) maximum.
2. If the flare is NOT in a pedestrian walking area, make the length of the curb cut slope (parallel to the flow-line) three (3) feet minimum.

D. Remove blade marks on sawed surfaces by grinding.

3.3 CURB REMOVAL FOR NEW CURB CUT ASSEMBLY

A. Reference: APWA Plan 235, 236, 237.

B. Curb Ramp or Blended Transition: Saw off curb to match the surface slope of the Curb Ramp or Blended Transition.

C Curb Flare: Saw off the curb perpendicular to the back of curb:

1. If the flare is in a pedestrian walking area, limit the curb cut slope (parallel to the flow-line) to 10 percent (1:10) maximum.
2. If the flare is NOT in a pedestrian walking area, typical horizontal length of the curb cut slope is two (2) feet.

D Remove blade marks on sawed surfaces by grinding.

3.4 TRIP HAZARD REMOVAL

A. **DO NOT cut or grind concrete structures** such as bridge decks, catch basins, manholes, concrete borders, culverts, etc. ENGINEER must determine other means of trip hazard removal.

B. Remove trip hazards greater than 1/4 inch high but less than 1 1/2 inches high. ENGINEER must determine acceptable means for removing trip hazards higher than 1 1/2 inches.

C. Make saw cut slopes, grinding slopes, and milled slopes not steeper than 10 percent (1:10) measured in direction of pedestrian travel. Grind sawed or milled surfaces to remove blade marks or to make smooth.

D. If flat work is jacked (Section 32 01 29), jack until displacement differential is less than 1/4 inch. Repair adjacent flat work elevations if adversely moved out of place because of the jacking process. Repair damaged form strip irrigation system or vegetation if growth is adversely affected.

3.5 CLEANING AND REPAIR

A. Remove debris and dust from work site.

B. Clean surrounding rails, concrete flat work, Driveways aprons, landscaping and other objects in vicinity of work.

C. Repair damage at no additional cost to OWNER.

END OF SECTION

DIVISION 03

CONCRETE

SECTION 03 11 00
CONCRETE FORMING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Formwork for cast-in-place concrete.

B. Openings in formwork for other affected work.

C. Form accessories such as snap ties, bracing, etc.

D. Stripping formwork.

1.2 REFERENCES

A. **ACI Standards**.

347 Recommended Practice for Concrete Formwork.

1.3 DEFINITIONS

A. **Shoring**: The activity to support formwork.

B. **Reshoring**: The activity to reduce the amount of formwork supporting concrete elements. As concrete sets and strength increases, less need for formwork occurs gradually until concrete becomes free standing.

1.4 SUBMITTALS

A. Shop Drawings: Fabrication and erection drawings of forms for specific finished concrete surfaces, as indicated. Show general construction of forms, jointing, special joints or reveals, location and pattern of form tie placement, and other items affecting exposed concrete visibility.

B. Form Release Agent: Where concrete surfaces are scheduled to receive special finishes or applied coverings which may be affected by agent submit manufacturer's instructions for use of agent.

1.5 QUALITY ASSURANCE

A. Designer's Qualifications: Structural design professional who complies with Utah licensing law, has experience in concrete formwork, and is acceptable to the authority having jurisdiction.

B. Design Forms:

1. With sufficient strength to maintain finished tolerances indicated in Section 03 35 00, to support loads, pressures, and allowable stresses as outlined in ACI 347 and for design considerations such as wind loads, allowable stresses, and other applicable requirements of local Laws and Regulations.
2. To permit easy removal.
3. For required finishes.

C. Design, engineering, and construction of formwork is CONTRACTOR's responsibility.

1.6 **JOB CONDITIONS**

A. For reference purposes, establish and maintain sufficient control points and bench marks to check tolerances. Maintain in an undisturbed condition and until final completion and acceptance of Work.

B. Regardless of tolerances specified, allow no portion of Work to extend beyond legal boundaries.

1.7 **FIELD SAMPLES**

A. Prepare field Samples and submit per Section 01 33 00.

B. Construct and erect sample formwork panel for architectural concrete surfaces receiving special treatment or finish as a result of formwork. Formwork to include vertical and horizontal form joints and typical rustication joints when required.

C. Size panel to indicate special treatment or finish required, including form release agent.

D. Remove formwork after casting concrete.

1.8 **ACCEPTANCE**

A. Secure ENGINEER's inspection of form layout for concrete flat work.

PART 2 PRODUCTS

2.1 **FORM MATERIALS**

A. Faced with material which will produce smooth and uniform texture on concrete, unless indicated otherwise.

B. Arrange facing material orderly and symmetrical, keeping number of seams to a minimum.

C. Do not use material with raised grain, patches, or other defects which will impair texture of concrete surface.

2.2 **FORMWORK ACCESSORIES**

A. Form Ties:

1. Use ties constructed so end fasteners can be removed without spalling concrete faces.

2. After end fasteners of ties have been removed, embedded portion of ties are to terminate not less than two (2) times the diameter or thickness of the fasteners from formed faces of concrete, but in no case greater than 3/4 inch.

3. When formed face on concrete is not exposed, form ties may be cut off flush with formed surfaces. Use ties with 3/4 inch diameter cones on both ends or an approved equal for water retaining structures.

B. Premolded Expansion Joint Filler: F1 sheet, Section 32 13 73 unless

indicated elsewhere.

C. Form Release Agent: Colorless material which will not stain concrete, absorb moisture, impair natural bonding or color characteristics of concrete. To prevent contamination, agents used on potable water structures are subject to review by ENGINEER before use.

D. Fillets for Chamfered Corners: Wood strips 1 inch x 1 inch size, maximum length possible.

PART 3 EXECUTION

3.1 INSPECTION

A. Verify lines, levels, and measurements before proceeding with formwork.

3.2 FORM CONSTRUCTION

A. Make forms sufficiently tight to prevent loss of concrete.

B. Unless indicated otherwise, place chamfer strips in corners of forms to produce beveled edges on permanently exposed exterior corners.

C. To maintain specified finish tolerances, camber formwork to compensate for anticipated deflections.

D. Provide positive means of adjustment using wedges, jacks, Shores, and struts to take up all settlement during concrete placing operation.

E. Provide temporary ports in formwork to facilitate cleaning and Inspection. Locate openings at bottom of forms to allow flushing water to drain.

F. At construction joints, overlap forms over hardened concrete at least six (6) inches. Hold forms against hardened concrete to prevent offsets or loss of mortar at construction joint and to maintain true surface.

G. Construct wood forms for wall openings to facilitate loosening, or counteract swelling.

H. Fasten wedges used for final adjustment of forms before concrete placement in position after final check.

I. Anchor formwork to Shores, supporting surfaces or members to prevent upward or lateral movement and deflection of any part of formwork system during concrete placement.

J. Provide runways for moving equipment with struts or legs, supported directly on formwork or structural member without resting on reinforcing.

K. Position expansion joint material and other embedded items accurately and support to prevent displacement.

L. To prevent entry of concrete, fill voids in sleeves, inserts, and anchor slots temporarily with readily removable material.

M. For architectural concrete, limit deflection of facing materials between studs as well as deflection of studs and walers to 0.0025 times span.

N. For underground concrete work, do not use soil walls for forming unless authorized by ENGINEER.

3.3 INSERTS, EMBEDDED PARTS, AND OPENINGS

A. Provide formed openings for elements embedded in or passing through concrete.

B. Coordinate work of other sections for the forming and setting of openings, slots, recesses, chases, sleeves, bolts, anchors, and other inserts.

C. Install accessories per manufacturer's instructions. Ensure items are not disturbed during concrete placement.

3.4 FORM FINISHES

A. Use forms with smooth rubbed, scrubbed, sand floated finishes that meet ACI 347 unless indicated otherwise.

B. For As-cast Finishes:

1. Install form panels in orderly arrangement with joints planned in approved relation to building elements.
2. Where panel joints are recessed or otherwise emphasized, locate form ties within joints, not within panel areas.
3. Where an as-cast finish is required, no grouting will be permitted in the finishing operation.

C. Textured Finishes: As indicated.

3.5 APPLICATION OF FORM RELEASE AGENT

A. Apply form release agent on formwork per manufacturer's instructions. Apply before placing reinforcing steel, anchoring devices, and embedded items.

3.6 FORM REMOVAL

A. Do not pry against face of concrete. Use only wooden wedges.

B. When repair of surface defects or finishing is required at an early age, remove forms as soon as concrete has hardened sufficiently to resist damage from removal operations.

C. Remove top forms on sloping surfaces of concrete as soon as concrete has attained sufficient stiffness to prevent sagging. Perform needed repairs or treatment required on such sloping surfaces at once, followed by specified curing.

D. Loosen wood forms for wall openings as soon as it can be accomplished without damage to concrete.

E. Formwork for columns, walls, sides of beams, and other members not supporting weight of concrete may be removed as soon as concrete has hardened sufficiently to resist damage from removal.

F. Where no Reshoring is planned, leave forms and Shoring used to support weight of concrete in beams, slabs, and other concrete members in place until concrete has attained its specified strength.

G. Where Reshoring is planned, supporting formwork may be removed

when concrete has reached 70 percent of specified strength, provided Reshoring is installed immediately.

H. When Shores and other vertical supports are so arranged that non-load carrying, form-facing material may be removed without loosening or disturbing Shores and supports, facing material may be removed at an earlier age.

3.7 **RESHORING**

A. When Reshoring is permitted or required, plan operations in advance and obtain approval.

B. During Reshoring do not subject concrete in beam, slab, column, or any other structural member to combined dead and construction loads and live loads in excess of loads permitted for developed concrete strength at time of Reshoring.

C. Place Reshores as soon as practical after stripping operations are complete, but in no case later than end of working day on which stripping occurs.

D. Tighten Reshores to carry required loads without over-stressing.

E. Leave Reshores in place until the concrete being supported has reached its specified strength.

F. For floors supporting Shores under newly placed concrete, level original supporting Shore or Reshore:

1. Reshoring system shall have a capacity to resist anticipated loads in all cases equal to at least 1/2 the capacity of the Shoring system.
2. Unless otherwise specified locate Reshores directly under a Shore.
3. In multistory buildings, extend Reshoring through a sufficient number of stories to distribute the weight of newly placed concrete, forms, and construction live loads in such a manner that design loads of floors and supporting Shores are not exceeded.

G. Design, engineering, and construction of Shoring and Reshoring is the responsibility of the CONTRACTOR.

3.8 **REMOVAL STRENGTH**

A. When removal of formwork or Reshoring is based on concrete reaching a specified strength, it shall be assumed that concrete has reached this strength when either of the following conditions has been met:

1. When test cylinders, field cured along with the concrete they represent, have reached the specified strength.
2. When concrete has been cured per Section 03 39 00 for the same length of time as the site-cured cylinders that reached specified strength. Determine the length of time the concrete has been cured in the structure by cumulative number of days or fractions thereof, not necessarily consecutive, during which the air temperature is above 50 deg F and concrete has been damp or sealed from evaporation and loss of moisture.

3.9 REUSE OF FORMS

A. Do not reuse forms if there is any evidence of surface wear or defect which would impair quality of concrete surface.

B. Thoroughly clean and properly coat forms before reuse.

3.10 FIELD QUALITY CONTROL

A. Before commencing a pour, verify connections, form alignment, ties, inserts and Shoring are placed and secure.

B. Observe formwork continuously while concrete is being placed to verify that the forms are plumb and there are no deviations from desired elevation, alignment, or camber.

C. If during construction any weakness develops and false-work shows undue settlement or discoloration, stop work, remove affected construction if permanently damaged, and strengthen false-work.

END OF SECTION

SECTION 03 20 00
CONCRETE REINFORCING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Reinforcing steel bars, wire fabric or rod mats for cast-in-place concrete.

B. Support chairs, bolsters, bar supports, and spacers for supporting reinforcement.

1.2 REFERENCES

A. **AASHTO Standards**:

M 254 Corrosion Resistant Coated Dowel Bars.

B. **ACI Standards**:

301 Structural Concrete for Buildings.

315 Concrete Reinforcement.

C. **ASTM Standards**:

A 82 Steel Wire, Plain, for Concrete Reinforcement.

A 185 Steel Welded Wire, Fabric, Plain, for Concrete Reinforcement.

A 615 Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

A 706 Low-Alloy Steel Deformed Bars for Concrete Reinforcement.

C 1116 Fiber-Reinforced Concrete and Shotcrete.

D 3963 Epoxy-Coated Reinforcing Steel.

D. **AWS Standards**:

D1.1 Structural Welding Code Steel.

D1.4 Structural Welding Code Reinforcing Steel.

E. **CRSI Standards**:

Manual of Standard Practice.

1.3 SUBMITTALS

A. Manufacturer's Certificate: Submit mill test certificates of supplied concrete reinforcement, indicating physical and chemical analysis.

B. Welder's certification.

C. Shop Drawings:

1. Indicate sizes, spacings, locations, and quantities of reinforcing steel, wire fabric, bending and cutting schedules, splicing, stirrup spacing, supporting, and spacing devices.
2. When required, prepare Shop Drawings by an engineer who complies with Utah licensing law and is acceptable to agency having jurisdiction.

1.4 **QUALITY ASSURANCE**

A. Perform concrete reinforcement work per CRSI Manual of Standard Practice.

B. Comply with ACI 301.

C. Welders: Certified to comply with AWS D1.1 or AWS D1.4 as applicable.

1.5 **ACCEPTANCE**

A. Unless specified otherwise, chairs for supporting reinforcement in flat slabs are spaced as follows:

1. Three (3) feet maximum for No. 5 and smaller bars.
2. Five (5) feet maximum for bars larger than No. 5.

B. Dowels are placed on dowel baskets and properly aligned.

C. Epoxy and galvanized coatings are not chipped or cut. Ends of cut bars are epoxy coated or galvanize painted before placement.

D. Minimum covering over reinforcement is as specified.

PART 2 PRODUCTS

2.1 **MATERIALS**

A. Fiber Reinforcement: Glass, ASTM C 1116.

B. Reinforcement:

1. Grade 60 ksi deformed steel bars, ASTM A 615 and supplementary requirements S1 or ASTM A 706 for welding.
2. Welded wire fabric. Plain steel type, ASTM A 185 in flat sheets or coiled rolls. Dimensions of the mesh 4”x 4” or as indicated.

C. Stirrups: Steel, ASTM A 82.

D. Dowel Bars for Expansion Joints: Grade 60 ksi smooth steel bar, ASTM A 615.

1. Galvanized or epoxy coated in roadway Pavements.
2. Provide plastic cap to permit longitudinal movement of dowel bar within concrete section equal to joint width plus 1/4 inch.
3. For load transfer joints, paint bars with 1 coat of paint conforming to AASHTO M 254 and coat 1/2 with grease.

E. Coatings for Corrosion Protection:
   1. Epoxy coat, ASTM D 3963.
   2. Galvanized, Section 05 05 10.

2.2 **ACCESSORY MATERIALS**

A. Tie Wire: Minimum 16 gage annealed type or an acceptable patented system.

B. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for strength and support of reinforcement during installation and placement of concrete.

2.3 **FABRICATION**

A. Fabricate reinforcement, ACI 315 providing for concrete cover.

B. Locate reinforcing splices not indicated on Drawings at points of minimum stress. Indicate location of splices on Shop Drawings.

C. Weld reinforcing bars; with AWS D1.4.

PART 3 EXECUTION

3.1 **PLACING**

A. All reinforcement to be free of loose mill scale, loose or thick rust, dirt, paint, oil or grease.

B. Place all reinforcement in the exact position indicated. With tie wire, tie bars together at all intersections except where spacing is less than 12 inches in each direction, in which case tie alternate intersections.

C. Maintain the distance from vertical forms and between layers of reinforcement by means of prefabricated chairs, ties, hangers, or other approved devices. Placing and fastening of reinforcement in each section of the Work must be approved before concrete is placed.

D. Overlap sheets of metal mesh one square plus six (6) inches to maintain a uniform strength. Securely fasten at the ends, edges, and supports to maintain clearances.

E. Flat Slab Work:
   1. Support reinforcing steel of formed flat slabs with plastic chairs, precast concrete blocks or other non-oxidizing slab bolsters.
   2. Size chairs or bolsters to position the steel in the exact location indicated.
   3. Space chairs and bolsters not more than five (5) feet on centers in each direction.
   4. Coat metal supports in contact with forms to prevent rust.
   5. Tie down deck steel to beams or forms at regular intervals of not more than five (5) feet on centers along the beams or forms to prevent movement of steel during concrete placement.

3.2 SPLICING

A. Furnish all reinforcement in the full lengths indicated unless otherwise permitted. Splicing of bars, except where indicated is not permitted without ENGINEER's knowledge. Stagger splices where possible.

B. Unless indicated otherwise, overlap reinforcing bars a minimum of 30 diameters to make the splice. In lapped splices, place the bars and wire to maintain the minimum distance for clear spacing to the surface of the concrete.

C. Do not use lap splices on bars greater than No. 11 diameter unless approved.

D. Weld reinforcing steel only if indicated or if authorized in writing. Weld in conformance to AWS D1.4.

E. Do not bend reinforcement after embedding in hardened concrete.

F. Do not permit reinforcement or other embedded metal items bonded to the concrete, to extend continuously through any expansion joint, except dowels in floors bonded on only one side of joints.

3.3 PLACING EMBEDDED ITEMS

A. Place all sleeves, inserts, anchors and embedded items before concrete placement. Temporarily fill voids in embedded items to prevent entry of concrete.

B. Give all trades whose work is related to the concrete section (Section 03 30 04) ample notice and opportunity to introduce or furnish embedded items before concrete placement.

END OF SECTION

SECTION 03 30 04
CONCRETE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Material requirements.

1.2 REFERENCES

A. **ACI Standards**:

211.1 Selecting Proportions for Normal, Heavyweight, and Mass Concrete.

211.2 Selecting Proportions for Structural Lightweight Concrete.

211.3 Standard Practice for Selecting Proportions for No-Slump Concrete.

214 Evaluation of Strength Test Results of Concrete.

301 Specifications for Structural Concrete for Buildings.

305 Hot Weather Concreting.

306 Cold Weather Concreting.

318 Building Code Requirements for Reinforced Concrete.

B. **ASTM Standards**:

C 33 Concrete Aggregates.

C 39 Compressive Strength of Cylindrical Concrete Specimens.

C 88 Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.

C 94 Ready-Mixed Concrete.

C 117 Material Finer than 75µ (No. 200) Sieve in Mineral Aggregates by Washing.

C 123 Lightweight Particles in Aggregate.

C 138 Unit Weight, Yield, and Air Content (Gravimetric) of Concrete.

C 142 Clay lumps and Friable Particles in Aggregates.

C 143 Slump of Hydraulic-Cement Concrete.

C 150 Portland Cement.

C 172 Sampling Freshly Mixed Concrete.

C 227 Potential Reactivity of Cement-Aggregate Combinations (Mortar Bar Method).

C 231 Air Content of Freshly Mixed Concrete by the Pressure Method.

C 260 Air-Entraining Admixtures for Concrete.

C 289 Potential Reactivity of Aggregates (Chemical Method).

C 295 Petrographic Examination of Aggregates for Concrete.

C 441 Effectiveness of Mineral Admixtures or Ground Blast-Furnace Slag in Preventing Excessive Expansion of Concrete Due to The Alkali-Silica Reaction.

C 494 Chemical Admixtures for Concrete.

C 535 Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

C 595 Blended Hydraulic Cements.

C 618 Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete.

C 1064 Temperature of Freshly Mixed Portland Cement Concrete.

C 1077 Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation.

C 1116 Fiber-Reinforced Concrete and Shot Crete.

C 1157 Blended Hydraulic Cement.

C 1240 Use of Silica Fume as a Mineral Admixture in Hydraulic Cement Concrete, Mortar, and Grout.

C 1260 Potential Alkali Reactivity of Aggregates (Mortar-Bar Method).

C 1293 Concrete Aggregates by Determination of Length Change of Concrete Due to Alkali-Silica Reaction.

C 1567 Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method).

C 1602 Mixing Water Used in The Production of Hydraulic Cement Concrete.

STP 15-C Manual on Quality Control of Materials.

1.3 SUBMITTALS

A. **Quality Assurance**:

1. Independent Laboratory: Submit names, certification levels, and years of experience of testing agency's field technicians that are assigned to the Work. Verify laboratory complies with ASTM and ACI standards.
2. Mixing Equipment: Submit certification of plant equipment.

B. **Mix Design**: Allow ENGINEER 10 days to evaluate the submittal. Provide the following information.

1. Date of mix design. If older than 365 days from date of submission recertify mix design.
2. Physical properties of the aggregate (see this section's article 2.3). Test results shall not be older 455 days from the date of submission.

The information is for suitability of source and not for project control. A new report may be required if aggregate source is changed.

3. Identify whether mix is for hot, cold, or normal weather placement.
4. Cement source, type and chemical composition.
5. Aggregate soundness and potential reactivity.
6. Average Strength (f_{cr}), per quality control chart.
7. Allowable range of slump and air content.
8. Water cement ratio.
9. Proportions of materials in the mix.
10. Unit weight.
11. Analysis of water if water is not potable.
12. Mortar bar or prism test results if a pozzolan is included in the mix.
13. Technical data sheets for additives to be used at the plant and at the job site. Certify additives are compatible with each other.

C. **Pre-approved Mix Design**: Submit name and address of Supplier and Suppliers mix design number if available.

D. **Before Changing Mix Design**: Submit a new design and allow ENGINEER 10 days to evaluate the changes.

1.4 QUALITY ASSURANCE

A. General:

1. Use a laboratory that follows and complies with ASTM C 1077.
2. Reject concrete that does not meet requirements of this section.
3. If requested, submit a quality control and testing report describing source and field quality assurance activities performed by CONTRACTOR and Suppliers.

B. At the Source:

1. Do not change material sources, type of cement, air-entraining agent, water reducing agent, other admixtures except as allowed by mix design.
2. Store bagged and bulk cement in weatherproof enclosures. Exclude moisture and contaminants.
3. Prevent segregation and contamination of aggregate stockpiles.
4. Avoid contamination, evaporation, or damage to admixtures. Protect liquid admixtures from freezing.

C. At the Site: Use of admixtures will not relax hot or cold weather placement requirements.

1.5 ACCEPTANCE

A. Materials:

1. Aggregate Source:
   a. Verify suitability of aggregate source.
   b. Verify aggregate gradation.
   c. Verify percent of combined aggregate passing No. 200 sieve.
2. At the Site:
   a. Verify mix identification, batch time, slump, air content, and temperature.
   b. Verify drum rotation is less than 300 revolutions.
3. At the Laboratory: Verify strength in 28 days.

B. Defective Material:

1. Price adjustment, Section 01 29 00 and Section 03 30 10.
2. Dispute resolution, Section 01 35 10.

PART 2 PRODUCTS

2.1 CEMENT

A. General:

1. Do not use air entraining cement except for hand mixed applications.
2. Do not use cement containing lumps or is partially set.
3. Do not mix cement originating from different sources.

B. Standard Set Cement:

1. Type II cement per tables 1 and 3 in ASTM C 150, or Type V when necessary, or
2. Low-alkali cement per Table 2 in ASTM C 150.

C. Blended Hydraulic Cement: The following are cement equivalencies when substituting blended cement for a portland cement.

Table 1 – Cement Equivalencies

Portland Cement ASTM C 150	Blended Cement ASTM C 595	Blended Cement ASTM C 1157
Type I	IP	GU
Type II	IP (MS)	MS
Type III	--	HE
Type IV	--	--
Type V	--	HS

D. Rapid Set Cement: As above and as follows:

1. Initial set time: 15 minutes minimum.

2. Color: Acceptable to the ENGINEER.

2.2 WATER

A. Clean, non-staining, non-detrimental per ASTM C 1602.

B. Screen out extraneous material.

C. Do not use alkali soil water.

2.3 AGGREGATES

A. Gravel, crushed gravel, crushed stone, crushed concrete, slag, sand or combination with the following physical properties.

Table 2 – Physical Properties

Property		ASTM	Min	Max	Units
Coarse Aggregate					
Wear (hardness or toughness) (a)		(a)	--	50	percent
Soundness (5 cycles)	Na_2SO_4	C88	--	12	percent
	Mg_2SO_4	C88	--	18	percent
Coal and lignite (SG = 2.4 min.) (b)		C123	0.5	1.0	
Clay lumps, friable particles, chert		C142	--	7	
Material finer than 200 sieve		C117	--	1.0	percent
Fine Aggregate					
Soundness (5 cycles)	Na_2SO_4	C88	--	10	--
	Mg_2SO_4	C88	--	15	--
Fineness modulus		C33	2.3	3.1	--
Coal and lignite (SG = 2.4 min.) (b)		C123	0.5	1.0	
Clay lumps, friable particles, chert		C142	--	3.0	percent
Aggregate blend (meets one of the following)					
1. Average prism length change in 12 months (c)		C1293	--	0.04	percent
2. Average mortar bar length change in 16 days (c)		C1260	--	0.10	percent
3. Petrography limits					
Quartz.....(d)		C295	--	5.0	percent
Chert or chalcedony			--	3.0	percent
Tridymite or cristobalite.....			--	1.0	percent
Opal.....			--	0.5	percent
Natural glass in volcanic rock			--	3	percent
4. Historical data acceptable to ENGINEER					

NOTES

(a) Wear retained on No. 8 sieve. For aggregate less than 1 1/2" use ASTM C131. For larger aggregates use ASTM C 535.

(b) Organic impurities producing a dark color concrete may cause rejection.

(c) Prism length change and mortar bar length change based upon unmodified ASTM tests.

(d) Quartz must NOT be optically strained, micro-fractured, or microcrystalline in nature.

2.4 ADDITIVES

A. Calcium Chloride: Not allowed in reinforced concrete.

B. Air Entrainment: ASTM C 260. For extrusion enhancement use non-vinsal resin.

C. Set Enhancement and Water Reducing Agents: ASTM C 494.

1. Type A: Water reducing.
2. Type B: Set retarding.
3. Type C: Set accelerating.
4. Type D: Water reducing and set retarding.
5. Type E: Water reducing and set accelerating.
6. Type F: High range water reducing (super plasticizer). *
7. Type G: High range water reducing and set retarding. *

* Keep the relative durability factor of water reducing additives not less than 90 and the chlorides content (as Cl^-) not exceeding 1 percent by weight of the admixtures.

D. Pozzolan:

1. Natural or fly ash per ASTM C 618.
2. Silica fume per ASTM C 1240.

E. Special Admixtures: Allowed if mix design submittal is accepted:

1. Lithium nitrate based solution for control of reactive aggregates.
2. Calcium nitrite based solution for corrosion protection of reinforced structures subject to chloride-induced corrosion.
3. Shrinkage reducer for controlling drying shrinkage in concrete.
4. Viscosity modifier for enhancement of self consolidating concrete or for workability.

2.5 MIX DESIGN

A. Selection of Cement: ASTM C 150 or C 1157.

1. For sulfate resistance, use Type V portland cement, or Type II with Class F fly ash. Class F fly ash may be used as an addition to Type V portland cement.
2. Do not use fly ash with Type IP(MS) or Type III portland cement.

B. Selection of Aggregates:

1. Maximum Particle Size:
   a. 1/5 of narrowest dimension between forms.
   b. 1/3 of depth of slab.
   c. 3/4 of minimum clear spacing between reinforcing bars.
2. Gradation: ASTM C 33.
   a. Coarse Aggregate: Choose from the following grades. Gradations are based upon percent of material passing sieve by weight.

Table 3 – Coarse Aggregate Gradation				
Sieve	**Grade**			
	357 (2”)	**467 (1.5”)**	**57 (1”)**	**67 (3/4”)**
2-1/2”	100	--	--	--
2 Inch	95 - 100	100	--	--
1-1/2”	--	95 – 100	100	--
1”	35 – 20	--	95 – 100	100
3/4"	--	35 – 70	--	90 – 100
1/2"	10 – 30	--	25- 60	--
3/8”	--	10 – 30	--	20 – 55
No. 4	0 – 5	0 – 5	0 – 10	0 – 10

b. Fine Aggregate:

Table 4 – Fine Aggregate Gradation	
Sieve	**Percent Passing by Weight**
3/8”	100
No. 4	95 to 100
No. 16	45 to 80
No. 50	10 to 30
No. 100	2 to 10

c. Silts and Clays: The amount of material smaller than the No. 200 sieve in any combined gradation sample is limited to the following percentages by weight of the combined sample:

1) 1.75 percent maximum for concrete subject to abrasion.

2) 3.0 percent maximum for all other concrete.

C. Selection of Pozzolan:

1. General: If a blended aggregate passes an unmodified ASTM C 1293 test, use of a pozzolan is CONTRACTOR’s choice. If aggregate does not pass ASTM C 1293, select a pozzolan (or blended cement, or both) and determine the effective dosage to meet one of the following tests:

a. ASTM C 1567. The expansion of a cement-pozzolan-aggregate job-mix mortar bar is less than or equal to 0.10 percent at 16 days. Do not use this test if a lithium admixture is used in the job-mix.

b. ASTM C 441. The expansion of a test mixture at 56 days is less than or equal to a control mixture prepared with cement with equivalent alkalis between 0.5 and 0.6 percent.

2. Fly Ash (Class F): Allowed as a cement replacement under the following conditions:

a. Before replacement is made, use the minimum cement content in the design formula to establish the water/cement ratio.

b. Replace up to 20 percent of the cement by weight on a one (1) part fly ash to one (1) part cement basis.

c. Submit to ENGINEER a quality history of the fly ash identifying a minimum of 20 of the most current ASTM C 618 analysis.

3. Natural Pozzolan (Class N): Allowed as a cement replacement if the 14 day expansion test (ASTM C 1567) with job aggregates, job cement and natural pozzolan does not exceed the 14 day expansion test of job aggregates, job cement and Class F fly ash.

4. Silica Fume: Allowed as a cement replacement if replacement of hydraulic cement on a 1 part silica fume to 1 part cement does not exceed 10 percent, and water/cement ratio is established before cement is replaced with silica fume.

D. Selection of Mix Properties: Select and proportion the mix to produce appropriate strength, durability and workability. Use ACI 211.1, 211.2, or 211.3, and meet the following properties and limitations:

Table 5 – Mix Properties and Limitations

Properties		Test Method	Class			
			2000	3000	4000	5000
Compressive Strength (f_c') at 28 days, psi, minimum		ASTM C 39	2000	3000	4000	5000
Compressive Strength at 7 days, psi, (for reference only)		ASTM C 39	1340	2010	2680	3350
Average Strength, psi (f_{cr})		ACI 214	(a)	(a)	(a)	(a)
Cement content, bags, minimum (b)		--	4.5	5.5	6.5	7.5
Water-cement ratio (by weight), maximum (c)		ACI 318	(d)	(d)	0.44	
Entrained air, percent (based upon aggregate size) (e)	2” 1-1/2” 1” 3/4"	ASTM C 231	3.0 to 6.0 ” ” ”	4.5 to 7.5 ” ” ”	4.0 to 7.0 4.5 to 7.5 5.0 to 7.5 5.0 to 7.5	
Slump		ASTM C 143	(d)	(d)	(d)	(d)

NOTES
(a). The amount by which average strength (f_{cr}) exceeds compressive strength (f_c') is based upon statistical assurance that no more than 1 test in 100 tests will fall below compressive strength (f_c').
(b) Unless allowed otherwise by ENGINEER.
(c) Before pozzolan substitution.
(d) Specific to exposure conditions and finishing need.
(e) Comply with ACI 211.1 if air content is changed.
(f) 1 bag of cement = 94 pounds.

1. Cold Weather: ACI 306. Unless allowed otherwise by ENGINEER, increase cement content in the mix design by 1 class between **October 1 and March 1,** i.e. Class 3000 becomes Class 4000, Class 4000 becomes Class 5000, etc.
2. Hot Weather: ACI 305. Reduce temperature of mix ingredients or use an admixture appropriate to job conditions when air temperature is over 75 deg F.
3. Concrete Deposited Under Water: Increase cement content one (1) class for concrete placed above water or use viscosity modifying admixture.

E. Selection of Fiber Reinforcement: The basis for determining material proportions of fiber-reinforced concrete is the Supplier's responsibility per ASTM C 1116 subject to mix property requirements of this Section. Unless specified otherwise provide synthetic fibers.

2.6 SOURCE QUALITY CONTROL

A. General: Collect Samples randomly. Do not change source quality control sampling point.

B. Aggregate:

1. Soundness, ASTM C 88.
2. Alkali-silica reactivity, ASTM C 289, C 1567, C1260, C 227 and C 1293.
3. Petrographically examine fine and coarse aggregate sources once every three (3) years, ASTM C 295.

C. Concrete Mix: Obtain samples per ASTM C 172 and run the following tests:

1. Compressive strength, ASTM C 39.
2. Unit weight, ASTM C 138.
3. Slump, ASTM C 143.
4. Air, ASTM C 231.
5. Temperature, ASTM C 1064.

D. Concrete Quality Charts: Comply with ACI 214 and ACI 301. Plot new results and identify trends on quality control charts that comply in form to ASTM STP 15-C. Show the Specified Strength (f_c'), the required Average Strength (f_{cr}), and the compressive strength versus date of Sample.

E. Equipment: Certify at least every two (2) years through the services of a design professional licensed in the State of Utah, that plant equipment complies with requirements of the National Ready Mixed Concrete Association and ASTM C 94.

1. Transit Trucks: Equip transit trucks with plates indicating total volume, agitating volume and mix volume.
2. Weights and Measures: Comply with regulatory requirements of State of Utah.

PART 3 EXECUTION

3.1 INSTALLATION

A. Placement, Section 03 30 10.

3.2 FIELD QUALITY CONTROL

A. Truck Mixed Concrete (Dry Batch): ASTM C 94.

1. Truck Mixer: Fill drum no more than 63 percent of the gross drum volume and no less than two (2) cubic yards. Use drum manufacturer's recommended mixing speed (between 12 – 18 rpm).
2. Truck Agitator: Do not fill drum greater than 80 percent of the gross drum volume. Use drum manufacturer's recommended agitating speed (between 2 – 6 rpm).

B. Mixing Plant: ASTM C 94.

1. Use option C and requirements in this Section for preparing ready-mixed concrete.
2. Use scales certified by the State of Utah. Do not use volume measurement except for water and liquid admixtures.
3. Mixing time must exceed 80 seconds after adding air entrainment admixture.

C. Hand Mixing:

1. Do not hand mix batches larger than 0.5 cubic yard.
2. Hand mix only on a watertight platform.
3. Ensure all stones are thoroughly covered with mortar and mixture is of uniform color and consistency before adding water.

END OF SECTION

SECTION 03 30 05
CONCRETE TESTING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Concrete sampling and testing requirements.

1.2 REFERENCES

A. **ACI Standards**:

318 Building Code Requirements for Reinforced Concrete.

B. **ASTM Standards**:

C 31 Making and Curing Concrete Test Specimens in the Field.

C 39 Compressive Strength of Cylindrical Concrete Specimens.

C 42 Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.

C 78 Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading).

C 136 Standard Method for Sieve Analysis of Fine and Coarse Aggregates.

C 138 Unit Weight, Yield, and Air Content (Gravimetric) of Concrete.

C 143 Slump of Portland Cement Concrete.

C 172 Sampling Freshly Mixed Concrete.

C 173 Air Content of Freshly Mixed Concrete by Volumetric Method.

C 231 Air Content of Freshly Mixed Concrete by the Pressure Method.

C 567 Unit Weight of Structural Lightweight Concrete.

C 1064 Temperature of Freshly Mixed Portland Cement Concrete.

C 1077 Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation.

1.3 SUBMITTALS

A. Concrete Supplier: If requested, submit reports and material certificates verifying concrete quality control.

B. Laboratory: Promptly submit test data results for seven (7) and 28 day breaks to Supplier, CONTRACTOR and ENGINEER.

1.4 QUALITY ASSURANCE

A. Provide an ASTM C 1077 compliant and ACI certified laboratory.

B. Provide level I ACI certified field sampling technicians.

1.5 SITE CONDITIONS

A. Assist ENGINEER: Furnish labor to assist ENGINEER in obtaining and handling acceptance Samples at site or sources.

B. Store and Cure Test Specimens: Safely store and cure concrete test specimens and acceptance test specimens for first 24 hours:

1. Follow ASTM C 31 in making and curing cylinders or beams at site. Do not move the cylinders or beams for the initial 16 hour cure period. Provide initial cure temperature as follows:

   a. 60 to 80 deg F for Class 4,000 or less.

   b. 68 to 78 deg F for Class 5,000 or greater.

2. Equip storage device with an automatic 24 hour temperature recorder with an accuracy of plus or minus two (2) deg F

3. Use water containing hydrated lime if water is to be in contact with cylinders or beams.

4. Ensure the device(s) can accommodate the required number of test cylinders or beams. Lack of capacity will cause the placement of concrete to cease.

5. Have the storage devices available at the point of placement at least 24 hours before placement.

6. A 24 hour test run may be required.

1.6 ACCEPTANCE

A. At the Laboratory:

1. Compressive strength, ASTM C 31.

2. Flexure strength, ASTM C 78.

B. At the Site:

1. Acceptance: Reject non-complying batches until two (2) consecutive batches are compliant then proceed in random batch testing for acceptance.

2. Sampling Protocol: ASTM C 172. Unless indicated otherwise follow Table 1 sampling frequency requirements. Collect sample at discharge chute before placement, or at pumper hose after priming grout has been wasted.

Table 1 – Sampling Frequency				
Rate of Placement (Cubic Yard / Day)	**Temperature**	**Air**	**Slump**	**Strength**
0 - 8	1	1	1	Determined by ENGINEER
0 - 50	1	1	1	1
Each additional 50 cu. yd. or fraction thereof	1	1	1	1

3. Testing Protocol:
   a. Temperature, ASTM C 1064.
   b. Air content, ASTM C 231 or ASTM C 173 if lightweight aggregate is used.
   c. Slump, ASTM C 143.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 PRECAST PRODUCTS

A. Obtain composite Samples from different portions of the batch.

B. Make and cure concrete test specimens for acceptance, ASTM C 31.

C. Cure all precast products with water vapor or water.

D. Do not damage precast products by stripping forms or handling before the concrete reaches its specified strength.

3.2 CAST-IN-PLACE PRODUCTS

A. Obtaining Samples:
   1. Batch samples, ASTM C 172.
   2. Core samples, ASTM C 42.

B. Identify location of tests on test reports.

C. Compressive strength, ASTM C 39:
   1. Mold four (4) test specimens, ASTM C 31.
   2. For strength test perform slump, air, unit weight, and temperature test.
   3. Break 1 cylinder at seven (7) days and three (3) cylinders at 28 days. The average strength of three (3) cylinder breaks shall be considered the test result.
   4. If any one cylinder in a 28 days test shows definite evidence of

improper sampling, molding, handling, curing, or testing, discard the cylinder. The average strength of the remaining cylinders shall be considered the test result.

D. Tensile (flexural) strength, ASTM C 78:
   1. Mold four (4) test specimens, ASTM C 31.
   2. For strength test perform slump, air, unit weight, and temperature test.
   3. Break 1 beam at seven (7) days and three (3) beams at 28 days. The average strength of the three (3) beam breaks shall be considered the test result.
   4. If any one beam in a 28 days test shows definite evidence of improper sampling, molding, handling, curing, or testing, discard the beam. The average strength of the remaining beams shall be considered the test result.

E. Aggregate, ASTM C 136 for fine and coarse aggregate.

F. Slump test, ASTM C 143.

G. Air Test:
   1. Normal weight concrete, ASTM C 231.
   2. Light weight concrete, ASTM C 173.

H. Unit Weight:
   1. Normal weight concrete, ASTM C 138.
   2. Light weight concrete, ASTM C 567.

I. When requested, test in-place concrete by impact hammer, sonoscope, or other non-destructive device:
   1. To determine relative strengths in various locations in Work.
   2. To aid in evaluating concrete strength.
   3. To select areas to be cored.
   4. To verify quality control in the absence of control testing.

3.3 RETESTING DEFECTIVE CONCRETE STRENGTH

A. If CONTRACTOR desires to do a retest, a request to ENGINEER for retesting must be made within 35 days from time of concrete placement. No coring or retesting shall be done after 40 days have elapsed from the time of placement:
   1. Choose three (3) random test locations and verify choice with ENGINEER. Obtain retest samples per ASTM C 42 and test compressive strength per ASTM C 39 or flexure strength per ASTM C 78.
   2. Establish a chain of custody for all test samples.
   3. If concrete placed in the Work will be dry under service condition, air dry cores for seven (7) days before tests. Unless otherwise specified, use air temperature 60 to 80 deg F and relative humidity less than 60 percent.

4. If concrete placed in the Work will be more than superficially wet under service conditions, test cores after moisture conditioning (liquid or vapor water cure).
5. If more than 1 core shows evidence of having been damaged before testing provide replacement cores, otherwise evaluation will be done on two (2) or more core samples.
6. Evaluate cores in accordance with ACI 318 requirements.
7. If core tests are inconclusive, or impractical to obtain, or if structural analysis does not confirm the safety of the Work, load test may be used and evaluated in accordance with ACI 318 requirements.

B. Coat sides of core hole with concrete epoxy resin adhesive. Fill core holes with non-shrink concrete mortar. Match color and texture of surrounding concrete.

C. Within 40 days from time of placement publish the chain of custody record and the results of retesting.

END OF SECTION

SECTION 03 30 10
CONCRETE PLACEMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Concrete placement for slabs on grade, slabs on fill, structural building frame, and other concrete components.

1.2 REFERENCES

A. **ACI Standards**:

301 Structural Concrete for Buildings.
305 Hot Weather Concreting.
306 Cold Weather Concreting.
309 Consolidation of Concrete.

B. **ASTM Standards**:

C 881 Epoxy-Resin-Base Bonding Systems for Concrete.
C 1059 Latex Agents for Bonding Fresh to Hardened Concrete.

1.3 SUBMITTALS

A. Batch Delivery Ticket: For each batch delivered to site, identify:

1. Date and Project description.
2. Producer and plant.
3. Name of contractor.
4. Serial number of ticket.
5. Mix identification number or code.
6. Truck number and time dispatched.
7. Volume of concrete.
8. Type and amount of cement.
9. Total water and water/cement ratio.
10. Water added for receiver of concrete and receiver's initials.
11. Admixture types.
12. Separate weights of fine and coarse aggregate.
13. Statement of whether batch is pre-mixed at plant or mixed in transit.

B. Record of Placed Concrete: Identify date of record, location of pour, quantity, air temperature, and CONTRACTOR's quality control test Samples taken.

C. Bonding Compound: Identify product name, type, and chemical analysis.

1.4 **QUALITY ASSURANCE**

A. Provide ACI certified finishers.

B. Remove and replace any placed concrete suffering hot or cold weather damage.

C. For control testing follow Section 03 30 05 requirements.

1.5 **ACCEPTANCE**

A **General**:

1. Price adjustment, Section 01 29 00. CONTRACTOR may request ENGINEER determine appropriate Modifications or payment adjustments to pay for Defective work.
2. Retesting by CONTRACTOR, Section 01 35 10 and Section 03 30 05.

B. Concrete work that fails to meet any of the following requirements will be considered defective. Replace Defective Work at no additional cost to OWNER:

1. Placement:
   a. Reinforcing steel size, quantity, strength, position, damage, or arrangement is not as specified or does not comply with code.
   b. Formwork differs from required dimensions or location in such a manner as to reduce concrete's strength or load carrying capacity or physical esthetics.
   c. Workmanship likely to result in deficient strength.
2. Finishing:
   a. Concrete exposed to view has defects that adversely affect appearance.
   b. Slab tolerances of Section 03 35 00 are not met.
3. Protection:
   a. Method of curing is not as specified.
   b. Inadequate protection of concrete during early stages of hardening and strength development from:
      1) temperature extremes.
      2) rapid moisture loss.
   c. Mechanical injury, construction fires, accidents, or premature removal of formwork likely to result in deficient strength development.

PART 2 PRODUCTS

2.1 MATERIALS

A. Concrete: Section 03 30 04. Class as indicated:

1. For roadway cuts, Section 33 05 25.

B. Bonding Compound: ASTM C 1059. Either polyvinyl acetate base or acrylic base latex:

1. Use type I in areas not subject to high humidity or immersion in water with minimum bond strength of 400 psi.
2. Use type II in areas subject to high humidity or immersion in water with minimum bond strength of 1250 psi.

C. Vapor Retarder: 10 mil thick clear polyethylene sheet. Type recommended for below grade application.

D. Forms: Section 03 11 00.

E. Reinforcement: Section 03 20 00.

F. Coverings and Curing Compound: Section 03 39 00.

G. Shrinkage Compensating Grouts: Section 03 61 00.

H. Epoxy Adhesive: Section 03 61 00.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify items to be cast into concrete are accurately placed and held securely.

B. Verify slump, air content range, mix identity, and batch time on delivery ticket matches mix design.

C. Verify slab steel mats are supported by steel chairs, precast concrete blocks, or other slab bolsters. Do not pour if absent.

3.2 PREPARATION

A. Implement the traffic control plan requirements Section 01 55 26.

B. Notify ENGINEER no later than 24 hours before commencement of concrete placement.

C. Do not allow construction loads to exceed structural capacity.

D. Clean previously placed concrete. Apply bonding compound per manufacturer's instructions.

E. At locations where new concrete is dowelled to existing work, drill, remove dust, insert and pack steel dowels with shrink compensating grout, and expansion caps where required.

3.3 DELIVERY

A. Concrete Temperature: Keep mixed concrete temperature before placement between 60 deg F. and 90 deg F.

B. Slump and Air Content: Keep within allowable ranges.

C. Transport Time:

Air Temperature	Time After Initial Batching
Less than 90 deg F	1–1/2 hours
Greater than 90 deg F	1–hour (without retarder)
Greater than 90 deg F	1–1/2 hours (with retarder)

To increase time past 1-1/2 hours, a hydration stabilizer that is acceptable to Supplier may be used.

D. Tempering:

1. Water may be added if all following conditions are met:
   a. The mix design water/cement ratio is not exceeded.
   b. The delivery ticket allows for addition of water based upon water/cement ratio.
   c. The amount of water added is accurately measured to within 1 gallon of the design addition.
   d. Water addition is followed by three (3) minutes of mixing at mixing speed before discharge.
   e. Supplier and CONTRACTOR mutually agree on who is authorized to add water.
2. **Do not add water after 1 cubic yard of concrete has discharged from the delivery vehicle.**

E. Super-plasticizer: Comply with manufacturer's requirements. If none, then as follows:

1. If added at site, add agent using injection equipment capable of rapidly and uniformly distributing admixture to concrete. Before discharge, mix for a minimum of five (5) minutes at a drum rate not less than 12 rpm or more than 15 rpm.
2. If added at plant, do not deliver to site unless batch delivery ticket displays water/cement ratio before super-plasticizer addition.

3.4 CONCRETE PLACEMENT

A. In General: ACI 301.

1. Do not disturb reinforcement, inserts, embedded parts, and formed joints.
2. Do not break or interrupt successive pours such that cold joints occur.
3. Honeycomb or embedded debris in concrete is not acceptable.

B. Hot Weather Placement: ACI 305. If the rate of evaporation approaches 0.2 lb./ft^2/hr. precautions against plastic shrinkage cracking are necessary. (i.e. dampening Subgrade and forms; placing concrete at the lowest possible temperature; erecting windbreaks and sunshades; fog sprays; use of evaporation retardants; or rescheduling time of placement).

C. Cold Weather Placement: ACI 306. Accelerating admixture may be used in concrete work placed at ambient temperatures below 50 deg F

Use of admixtures will not relax cold weather placement, curing, or protection requirements. . If air temperature is forecasted to fall below 32 deg F. within 14 days of placement, proceed as follows:

1. Provide cold weather protection (cover, insulation, heat, etc.).
2. Do not use chemical "anti-freeze" additives in the concrete. (NOTE: this does not apply to normal accelerators.)
3. Do not proceed with the placement of concrete until the temperature of all contact surfaces is 35 degrees F and ambient temperature is ascending.
4. Protect the concrete from freezing until a compressive strength of at least 90 percent of design strength has been achieved, determined by either:
   a. Maturity meter. Refer to AASHTO T 325, or.
   b. Field cured cylinders.
5. Adequately vent combustion-type heaters that produce carbon monoxide.
6. When applying external heat, maintain moist conditions to avoid excessive moisture loss from concrete.
7. When removing heat, limit drop in temperature of concrete surfaces to 20 degrees F during any 12 hour period until the surface temperature of the concrete reaches that of the atmosphere.

D. Concrete Temperature: Keep mixed concrete temperature at time of placement between 60 deg F and 90 deg F

E. Do not disturb reinforcement, inserts, embedded parts, and formed joints.

F. Do not break or interrupt successive pours such that cold joints occur.

G. Honeycomb or embedded debris in concrete is not acceptable.

3.5 JOINTS AND JOINT SEALING

A. Steel edging and jointing tools are acceptable. Preferred are magnesium, aluminum or wood tools

B. Pavement joint sealing, Section 32 13 73.

3.6 CONSOLIDATION

A. Keep spare vibrator available during concrete placement operations.

B. Follow ACI 309 requirements.

3.7 CURING

A. Section 03 39 00. Use a membrane forming compound unless specified otherwise.

3.8 FINISHING

A. Section 03 35 00 and as follows.

Table 1 – Finishes	
Type of work	**Finish**
Sidewalks, garage floors, ramps, exterior concrete Pavement	Broom or belt
Exterior platforms, steps, and landings, exterior and interior pedestrian ramps, not covered by other finish materials	Non-slip
Surfaces intended to receive bonded applied cementitious applications	Scratched
Surfaces intended to receive roofing, except future floors, waterproofing membranes, and roof surfaces that are future floors or sand bed terrazzo	Floated
Floors and roof surfaces that are floors intended as walking surfaces or to receive floor coverings	Troweled
Unpainted concrete surfaces not exposed to public view	Rough as-cast form finish
Unpainted concrete surfaces exposed to public view	Smooth as-cast form finish
Concrete surfaces to receive paint or plaster	Grout cleaned finish

3.9 PROTECTION AND REPAIR

A. Protection, Section 01 66 00:

1. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, graffiti, and mechanical injury.
2. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

B. Repair:

1. Modify or replace concrete not conforming to required levels, lines, details, and elevations.
2. Structural analysis and additional testing may be required at no additional cost to OWNER when the strength of a structure is considered potentially deficient.
3. To patch imperfections refer to Section 03 35 00 requirements.
4. Remove graffiti and mechanical injury.

END OF SECTION

SECTION 03 35 00
CONCRETE FINISHING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Finishing interior and exterior concrete surfaces.

1.2 REFERENCES

A. **ACI Standards**:

303 Guide to Cast-in-Place Architectural Concrete Practice.

1.3 SUBMITTALS

A. Name, type, chemical analysis and manufacturer's recommended rate of application for liquid chemical hardener.

1.4 PROJECT CONDITIONS

A. Protect adjacent materials and finishes from dust, dirt and other surface or physical damage during finishing operations. Provide protection as required and remove from site at completion of Work.

PART 2 PRODUCTS

2.1 MATERIALS

A. Masonry Mortar and Grout: Section 04 05 16.

B. Dry Shake: Blend of metallic or mineral aggregate with Portland cement concrete in proportions recommended by manufacture.

C. Proprietary Materials: If permitted or required, proprietary compounds may be used in lieu of or in addition to foregoing blended materials. Use such compounds per manufacturer's recommendations.

D. Liquid-Chemical Hardener: Colorless, aqueous solution containing a blend of magnesium fluosilicate, zinc fluosilicate and a wetting agent. Mixture contains not less than two (2) pounds fluosilicate per gallon and does not interfere with adhesives and bonding.

PART 3 EXECUTION

3.1 PREPARATION

A. Examine areas and conditions under which work of this section will be performed.

B. Correct conditions detrimental to timely and proper finishing.

C. Do not proceed until unsatisfactory conditions are corrected.

3.2 **FINISHING HORIZONTAL SLABS**

A. **Do not apply water (i.e. sprinkle) to any surface of concrete when finishing slabs.**

B. Edges and Joints: Tools may be made out of steel. Preferred is wood, aluminum or magnesium.

C. Tolerances:

1. Class A: 1 in 1000.
2. Class B: 1 in 500.
3. Class C: 1 in 250.

D. Float Finish: After concrete has been placed, consolidated, struck-off, and leveled, do not work further until ready for floating:

1. Begin floating when water sheen has disappeared and surface has sufficient stiffness.
2. During or after first floating, check planeness of entire surface with a 10 feet long straightedge applied at two (2) or more different angles.
3. Cut down high spots and fill low spots to the required tolerance.
4. Refloat slab immediately to a uniform sandy texture.

E. Trowel Finish:

1. Do not use steel trowel or a power trowel on exterior concrete or on concrete that contains more than three (3) percent air.
2. First troweling shall produce smooth surface relatively free of defects but which may still show some trowel marks.
3. Second troweling after surface has stiffened shall make finished surface essentially free of trowel marks, uniform in texture and appearance.
4. On surfaces intended to support floor coverings, grind off defects that would show through floor covering.

F. Broom or Belt Finish: Sweep surface with brushes, rakes, tines or burlap belt before final set.

G. "Dry Shake" Finish: Give the surface a floated finish. Evenly apply approximately 2/3 of a blended unsegregated material:

1. Begin floating immediately after application of first "dry shake".
2. After material has been embedded by floating, apply remainder of blended material to surface at right angles to previous application.
3. Make second application heavier in any areas not sufficiently covered by first application.
4. Immediately follow with second floating.
5. After selected material has been embedded by second floating, complete operation with a broomed, floated, or troweled finish, as indicated.

H. Non-slip Finish: Give surface a "dry shake" application, using crushed ceramically bonded aluminum oxide particles. Apply at 25 pounds per 100 square feet.

I. Exposed Aggregate Finish: Immediately after surface of concrete has been leveled to tolerance and surface water has dissipated, spread aggregate uniformly over surface to provide complete coverage to the depth of a single stone:

1. Embed aggregate into surface by light tamping.
2. Float surface until embedded aggregate is fully coated with mortar and surface has been brought to tolerance.
3. Start exposure of aggregate after matrix has hardened sufficiently to prevent dislodgment.
4. Flow ample quantities of water, without force, over surface of concrete while matrix encasing aggregate is removed by brushing with a fine bristle brush.
5. Continue until aggregate is uniformly exposed.
6. An approved chemical retarder sprayed onto freshly floated surface may be used to extend working time.

J. Chemical-Hardener Finish: Apply liquid chemical-hardener finish to interior concrete floors where indicated. Do not apply liquid chemical hardener on floor areas scheduled to receive synthetic matrices terrazzo, setting beds for tile, terrazzo, vinyl flooring, or like items. Apply hardener after complete curing and drying of concrete surface per manufacturer's recommendations. Evenly apply each coat, and allow 24 hours for drying between coats. After final coat of chemical-hardener solution is applied and dried, remove surplus hardener by scrubbing and mopping with water.

3.3 FINISHING FORMED SURFACES

A. General:

1. Allow concrete to cure not more than 72 hours before commencing surface finish operations, unless approved otherwise.
2. Revise the finishes as needed to secure approval.

B. As-Cast Form Finish:

1. Rough: Patch defects, chip or rub off fins exceeding 1/4 inch height.
2. Smooth: Patch tie holes and defects and remove fins completely:
   a. When surface texture is impaired and form joints misaligned, grind, bush-hammer, or correct affected concrete.
   b. Slurry grout areas evidencing minor mortar Leakage to match adjacent concrete.
   c. Repair major mortar Leakage as a defective area.
   d. When workmanship is less than acceptable standard, provide one of rubbed finishes at no additional cost to OWNER.

C. Rubbed Finishes:
   1. Smooth: Remove forms and perform necessary patching as soon after placement as possible:
      a. Finish newly hardened concrete no later than 24 hours following form removal.
      b. Wet surfaces and rub with carborundum brick or other abrasive until uniform color and texture are produced.
   2. Grout Cleaned: Undertake no cleaning operations until all contiguous surfaces are completed and accessible:
      a. Wet surface of concrete sufficiently to prevent absorption of water from grout.
      b. Apply grout uniformly.
      c. Immediately after grouting, scrub surface with cork float or stone to coat surface and fill voids.
      d. While grout is still plastic, remove excess grout by working surface with rubber float or sack.
      e. After surface whitens from drying, rub vigorously with clean burlap.
      f. Keep damp for at least 36 hours after final rubbing.
   3. Cork Floated: Remove forms within two (2) to three (3) days of placement where possible:
      a. Remove ties.
      b. Remove all burrs and fins.
      c. Dampen wall surface.
      d. Apply mortar with firm rubber float or with trowel, filling all surface voids.
      e. Compress mortar into voids.
      f. If mortar surface dries too rapidly to permit proper compaction and finishing, apply a small amount of water with fog sprayer.
      g. Produce final texture with cork float using a swirling motion.

D. Unformed Finish:
   1. After concrete is placed, strike smooth, tops of walls or buttresses, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces.
   2. Float to texture that is reasonably consistent with formed surfaces.
   3. Continue final treatment on formed surfaces uniformly across uniformed surfaces.

E. Blasted Finish:
   1. Perform abrasive blasting within 24 to 72 hours after casting.
   2. Coordinate with form work construction, concrete placement schedule, and formwork removal to ensure that surfaces are blasted at the same age for uniform results.

3. Reapply curing protection after blast finishing

F. Architectural Finish, ACI 303:

1. Tooled Finish:

a. Dress thoroughly cured concrete surface with electric, air, or hand tools to uniform texture, and give a bush hammered surface texture.

b. Remove sufficient mortar to exposed coarse aggregate in relief and to fracture coarse aggregate for tooled finish.

G. Patched Finish:

1. Repair defective areas:

a. Remove honeycomb and defective concrete to sound concrete.

b. Make edges perpendicular to surface or slightly undercut.

c. Feather edges are not permitted.

d. Dampen area to be patched and at least six (6) inches surrounding it to prevent absorption of patching mortar water.

e. Prepare bonding grout.

f. Mix to consistency of thick cream.

g. Brush into surface.

2. Tie Holes: Unless indicated otherwise, after being cleaned and thoroughly dampened, fill tie hole solid with patching mortar.

3. Make patches in concrete closely match color and texture of surrounding surfaces. Determine mix formula for patching mortar by trial and obtain a good color match with concrete when both patch and concrete are cured and dry:

a. Mix white and gray Portland cement as required to match surrounding concrete to produce grout having consistency of thick paint.

b. Use a minimum amount of mixing water.

c. Mix patching mortar in advance and allow to stand without frequent manipulation, without addition of water, until it has reached stiffest placeable consistency.

d. After initial set, dress surfaces of patches manually to obtain same texture as surrounding surfaces.

4. After surface water has evaporated from patch area, brush bond coat into surface:

a. When bond coat begins to lose water sheen, apply patching mortar.

b. Thoroughly consolidate mortar into place and strike-off to leave patch slightly higher than surrounding surface.

c. Leave undisturbed for at least one (1) hour before final finish.

d. Keep patched area damp for 72 hours or apply curing compound.

e. Do not use metal tools in finishing an exposed patch.

5. Where as-cast finishes are indicated, total patched area may not exceed 1 in 500 of as-cast surface. This is in addition to form tie patches, if ties are permitted to fall within as-cast areas.

6. In any finishing process which is intended to expose aggregate on surface, patched areas must show aggregate:

   a. Outer 1 inch of patch shall contain same aggregate as surrounding concrete.

   b. For aggregate transfer finish, patching mixture shall contain same selected colored aggregates.

   c. After curing, expose aggregates together with aggregates of adjoining surfaces by same process.

END OF SECTION

SECTION 03 39 00
CONCRETE CURING

PART 1 GENERAL

1.1. **SECTION INCLUDES**

A. Concrete curing requirements.

1.2 **REFERENCES**

A. **ACI Standards**:

301 Structural Concrete for Buildings.

305 Hot Weather Concreting.

306 Cold Weather Concreting.

B. **ASTM Standards**:

C 171 Sheet Materials for Curing Concrete.

C 1315 Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.

1.3 **SUBMITTALS**

A. Curing agent data sheet.

B. Curing plan. Describe estimated cure quantity and procedure.

C. Manufacturer certificates, Section 01 33 00 that shows product meets performance criteria.

D. Manufacturer's recommended installation procedures which, when accepted by ENGINEER, will become the basis for accepting or rejecting installed product.

1.4 **QUALITY ASSURANCE**

A. Use workers knowledgeable of ACI 301, 305, 306.

1.5 **PRODUCT HANDLING**

A. Protect materials of this Section before, during, and after installation.

B. Protect the work and materials of other trades.

C. In the event of damage, immediately make replacements and repair at no additional cost to OWNER.

1.6 **WEATHER LIMITATIONS**

A. Above 75 deg F, ACI 305

B. Below 55 deg F, ACI 306.

PART 2 PRODUCTS

2.1 COVERS

A. Water or Fog-spay: Clean, non-staining and non-detrimental to concrete.

B. Sheet Coverings: White waterproof paper, polyethylene film, or polyethylene coated burlap sheet complying with ASTM C 171.

C. Mat Coverings: Clean roll goods of cotton or burlap fabric.

D. Insulating Coverings: Non-staining curing blankets.

2.2 MEMBRANE FORMING COMPOUND

A. Material:
   1. Styrene-acrylic.
   2. Styrene-butadiene.
   3. Alpha-methylstyrene.

B. Reference: ASTM C 1315:
   1. Type II Class A or B (white pigmented).
   2. Type ID Class A (clear with fugitive dye).

C. Volatile Organic Compounds (VOC): Comply with local, state and federal requirements.

PART 3 EXECUTION

3.1 PREPARATION

A. *DO NOT DILUTE CURING COMPOUNDS.*

B. Do not use membrane forming curing compound on surfaces that are to receive hardeners.

C. Commence curing operation within 20 minutes after finishing.

3.2 APPLICATION – COVERS

A. Water: Apply water-fog spray or ponding.

B. Absorptive Mat: Place absorptive mat to provide coverage of concrete surfaces and edges. Lap over adjacent absorptive covers. Thoroughly saturate with water and keep continuously wet.

C. Moisture-Retaining Sheet: Place cover in widest practicable width with sides and ends lapped and sealed to prevent moisture loss. Repair any holes or tears during curing period.

D. Formed Surface Curing: Cure formed concrete surfaces, including underside of beams, supported slabs and other similar surfaces by moist curing with forms in place for full curing period. If forms are removed before curing completion, applying cure film or penetrant or use methods indicated above, as applicable.

3.3 APPLICATION – MEMBRANE FORMING COMPOUND

A. Apply coating continuously and uniformly. Follow manufacturer's recommendations.

B. Protect continuity of film coatings and repair damage during cure period.

C. If forms are removed before expiration of cure period, apply coating to unprotected areas.

3.4 CONCRETE CURE TEMPERATURE

A. During cure period, eliminate thermal shock of concrete by keeping cure temperature even throughout extent and depth of concrete.

3.5 SCHEDULE

A. Concrete Exposed to Potable Water (as in Water Storage reservoirs):
   1. Moisture cover curing, or
   2. Acrylic cure, or
   3. Styrene acrylic silane co-polymer cure.

END OF SECTION

SECTION 03 40 00
PRECAST CONCRETE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pre-cast concrete, complete with required connecting and supporting devices.

1.2 REFERENCES

A. **ACI Standards**:

318 Building Code Requirements for Reinforced Concrete. This reference standard includes ASTM material standards.

B. **ASTM Standards**:

A 36: Structural Steel.

C 478 Precast Reinforced Concrete Manhole Sections.

C 857 Minimum Structural Design Loading for Underground Precast Concrete Utility Structures.

C 858 Underground Precast Concrete Utility Structures.

C 891 Installation of Underground Precast Concrete Utility Structures.

C. **AWS Standards**:

D1.1 Structural Welding Code Steel.

D1.4 Structural Welding Code Reinforcing Steel.

D. **PCI Standards**:

Design Handbook.

MNL-116 Quality Control and Assurance for Plant Production of Prestressed Concrete.

MNL-117 Quality Control and Assurance for Plant Production of Architectural Precast Concrete.

1.3 DESIGN CRITERIA

A. Design structural precast concrete units, ACI 318 and PCI design handbook.

B. Design utility precast units, ASTM C 857 and C 858.

C. Under direct supervision of a design professional who is fully experienced in design of units.

D. Design units to support required stripping and handling loads, and live, dead and construction loads.

E. Design component connections to provide adjustment to accommodate misalignment of structure during installation.

1.4 SHOP DRAWINGS

A. Prepare Shop Drawings under seal of a licensed design professional.

B. Submit Shop Drawings, Section 01 33 00.

C. Indicate unit locations, unit identification marks, fabrication details, reinforcement, connection details, pertinent dimensions, and erection support points. Unit identification marks to appear on all manufactured units.

D. Do not proceed with fabrication until Shop Drawings have been accepted.

1.5 QUALITY ASSURANCE

A. Manufacturer:
   1. Prestressed: PCI certified.
   2. Precast Concrete Units: PCI or NPCA certified
   3. Precast Utility Structures and Pipe: ACPA certified.

B. Transporter: Acceptable to manufacturer.

C. Erector:
   1. Prestressed: PCI certified.
   2. Precast: Has five (5) years minimum experience in erecting precast units.

D. Welders: Certified, AWS D1.1 and AWS D1.4.

1.6 DELIVERY, STORAGE AND HANDLING

A. Handle precast units in positions consistent with their shape and design. Lift and support only from support points indicated on Shop Drawings.

B. Embedded Lifting or Handling Devices: Capable of supporting units in positions anticipated during manufacture, storage, transportation, and erection.

C. Block and laterally brace units while stored at manufacturers. Provide lateral bracing that is sufficient to prevent bowing and warping that is clean, nonstaining, and will not inhibit uniform curing of exposed surfaces.

D. Provide edges of units with adequate protection to prevent staining, chipping, or spalling of concrete.

E. Unless otherwise approved in writing, do not deliver units to job site until required for installation.

PART 2 PRODUCTS

2.1 CONCRETE

A. Above Ground: 5000 psi minimum, Section 03 30 04 and ACI 318.

B. Underground: Class 4000 minimum, Section 03 30 04 and ASTM C 478 or ASTM C 858.

2.2 ACCESSORIES

A. Connecting and Supporting Devices: Steel, ASTM A 36.

B. Bolts, Nuts, and Washers: High-strength steel. Section 05 05 23.

C. Reinforcement: Grade 60 billet steel bars, Section 03 20 00 plain finish

2.3 FABRICATION

A. Maintain plant records and quality control program during production of structural precast concrete. Make records available to ENGINEER.

B. Use molds which are rigid and constructed of material that will result in uniform finished products.

C. If self consolidating concrete is NOT used, vibrate concrete to ensure proper consolidation, elimination of unintentional cold joints, and minimize entrapped air on surface.

D. Fabricate required connecting devices, plates, angles, items fit to steel framing members, bolts and accessories.

E. Ensure reinforcing steel, anchors, inserts, plates, angles, and other cast-in items are sufficiently embedded, anchored and property located.

F. Ensure finished surfaces of precast structural units are uniform.

G. Cure units under identical conditions to develop specified concrete quality, and minimize appearance blemishes such as non-uniformity, staining or surface cracking.

2.4 DESIGN DEVIATIONS

A. Deviation: Provide installation equivalent to basic intent without additional cost to OWNER. Deviations from exact required cross-section will be permitted only with approval.

B. Manufacturer's Proposed Design: Supported by complete design calculations and drawings. When requested, submit design calculations for review bearing seal and signature of a licensed design professional.

2.5 OPENINGS

A. Provide required openings, six (6) inches or larger. If approved, smaller sizes may be field constructed by coring or sawing.

2.6 FINISHES

A. General: Required finish will be described in one of the following paragraphs. If no finish is indicated or selected by ENGINEER, provide Standard Finish.

B. Standard Finish: Produced in forms such as plastic or metal lined that impart a smooth finish to the concrete. Small surface holes, normal form joint marks, minor chips and spall are acceptable if approved. Major or unsightly imperfections, honeycomb or structural defects are not acceptable.

C. Commercial Finish: Produced in forms such as plywood or lumber that impart texture to concrete. Remove fins and large projections. Fill holes over 3/8 inch. Make faces true and well defined. Correct exposed ragged edges by rubbing or grinding.

D. Architectural Grade A Finish: Produced in forms such as plastic or metal lined that impart smooth finish to concrete. Fill holes over 1/4 inch in diameter with sand-cement paste. Grind smooth form offsets or fins over 1/8 inch. Coat with neat cement paste using float. After paste coat has dried, rub with burlap to remove loose particles.

E. Architectural Grade B Finish: Produced in forms such as plastic or metal lined that impart smooth finish to concrete. Fill holes over 1/4 inch in diameter with sand-cement paste. Grind smooth form offsets or fins over 1/8 inch.

F. Special Finishes: Sandblasting, acid washing, retarders or form liners as approved by ENGINEER. Special finishes require submittal of two 12 x 12 inch Samples showing a representative color and texture to be used.

G. Painted Finishes: On concrete to be painted, use a form release agent acceptable to the paint manufacturer.

2.7 **REPAIR**

A. Repair of damaged units is acceptable if structural integrity or appearance is not impaired.

2.8 **ALLOWABLE TOLERANCES**

A. Length: Plus or minus 3/4 inch, or plus or minus 1/8 inch per 10 feet of length, whichever is greater, or as indicated.

B. End Squareness: 1/2 inch maximum.

C. Blockouts: 1 inch of centerline location indicated.

PART 3 EXECUTION

3.1 **INSTALLATION**

A. Do not install precast units until concrete has attained its design compressive strength.

B. Install members plumb, level, and in alignment within PCI MNL-116 or PCI MNL-117 and indicated limits of erection tolerances.

C. Clean weld marks or other marks, debris, or dirt from exposed surfaces of units.

D. Install underground utility precast units per ASTM C 891.

3.2 **PERFORMANCE REQUIREMENTS**

A. Conduct inspections, perform testing, and make repairs or replace unsatisfactory precast units as required.

B. Rejection: Units may be rejected for any one of the following:
   1. Exceeding specified installation tolerances.
   2. Damaged during construction operations.
   3. Exposed-to-view surfaces which develops surface deficiencies.
   4. Other defects as listed in PCI MNL-116 or PCI MNL-117.

END OF SECTION

SECTION 03 61 00
CEMENTITIOUS GROUTING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pre-mixed non-metallic shrinkage resistant grout, pre-mixed water stop hydraulic cement grout, epoxy grout, and portland cement grout:

1. Grout for leveling beds of structural steel plates.
2. Sealing of joints and gaps between piping and structures.
3. Sealing of joints between construction components.

1.2 REFERENCES

A. **ASTM Standards**:

C 109 Compressive Strength of Hydraulic Cement Mortars (Using 2 in. or 50 mm Cube Specimens).

C 144 Aggregate for Masonry Mortar.

C 150 Portland Cement.

C 190 Tensile Strength of Hydraulic Cement Mortars.

C 207 Hydrated Lime for Masonry Purposes.

C 472 Physical Testing of Gypsum Plasters and Gypsum Concrete.

C 595 Blended Hydraulic Cements.

C 881 Epoxy - Resin - Base Bonding Systems for Concrete.

C 1090 Measuring Changes in Height of Cylindrical Specimens from Hydraulic-Cement Grout.

C 1107 Packaged Dry Hydraulic Cement (Non-Shrink).

C 1157 Blended Hydraulic Cement.

D 570 Water Absorption of Plastics.

D 638 Tensile Properties of Plastics.

D 695 Compressive Properties of Rigid Plastics.

1.3 SUBMITTALS

A. Grout mix components. Indicate proportions used, environmental conditions, and admixture limitations. Indicate material "Type", "Grade", and "Class" which suits Project requirements.

B. Manufacturer's data for latex bonding agent.

PART 2 PRODUCTS

2.1 MATERIALS - GENERAL

A. Cement:

1. Portland: Natural color Type II (normal) or Type IIA (air entrained), ASTM C 150.
2. Blended: ASTM C 595 or C 1157.

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

C. Water: Clean, non-staining, non-detrimental.

D. Aggregate: Standard masonry type, ASTM C 144.

2.2 PORTLAND CEMENT GROUT

A. Proportions by Volume: One part portland cement, and sand equal to 2-1/2 to three times sum of volumes of cement and lime.

B. Mix thoroughly with water to form a stiff workable plastic putty.

C. Compressive Strength: 2800 psi in 28 days, ASTM C 109.

2.3 GYPSUM PLASTER GROUT

A. Premixed, prepackaged, wood fiber gypsum plaster with an ASTM C 472 minimum average dry compressive strength of 2000 psi in 28 days.

B. Mix with water per manufacturer's instructions for intended use to form a stiff plastic mix required for workability.

2.4 CEMENT BASED SHRINKAGE RESISTANT GROUT

A. Grade B or Grade C: ASTM C 1107. Premixed, non-metallic, non-gaseous product at a fluid consistency (flow cone) of 20 to 30 seconds. Thirty-minute-old grout shall flow through flow cone after slight agitation, in temperatures of 40 deg F to 90 deg F

B. Bleeding: None.

C. Compressive Strength: 6500 to 9000 psi in 28 days, ASTM C 109.

D. Non-shrink percentage: 0.5 percent, ASTM C 1090.

2.5 EPOXY ADHESIVE GROUT

A. Two component material, ASTM C 881. Suitable for use on dry or damp surfaces, 100 percent solids, high modulus, moisture insensitive:

1. Tensile Strength: 5000 psi minimum in 14 days, ASTM D 638.
2. Tensile Elongation: Two (2) percent minimum, ASTM D 638.
3. Compressive Strength: 6500 psi minimum in 24 hours and 70 deg F, 12,500 psi in 28 days and 70 deg F , ASTM D 695.
4. Water Absorption: One percent maximum, ASTM D 570.
5. Bond Strength:

a. Direct Shear: 400 psi.

b. Direct Tension: 250 psi.

c. Beam Break: 800 psi.

6. Pot Life: Five minutes maximum at 70 deg F

2.6 **BONDING GROUT**

A. Of approximately one part cement to one part fine sand passing a No. 30 sieve with approved latex bonding agent when allowed.

2.7 **PNEUMATICALLY PLACED PLASTER ("GUNITE" OR "SHOTCRETE")**

A. Materials: Portland cement, lime, water and sand.

B. Compressive Strength: 2800 psi in 28 days, ASTM C 109.

C. Proportioning: One part cement to not more than five parts sand.

PART 3 EXECUTION

3.1 **INSTALLATION**

A. Fill joints, voids, and pockets, completely.

B. Comply with manufacturer's instructions and UBC Chapter 47.

C. Finish surfaces exposed to view smooth.

D. Pneumatically Placed Plaster: Screened and reused rebound material in an amount not greater than 25 percent of the total sand in any batch.

END OF SECTION

SECTION 25 56 00 – INTEGRATED AUTOMATION OF ELECTRICAL EQUIPMENT (SCADA)

PART 1 - GENERAL

1.1 WORK INCLUDED:

A. Work includes additions to an existing Supervisory Control and Data Acquisition (SCADA) system providing automation of electrical equipment.

B. Provide all wiring, equipment, programming as herein specified and shown on the associated drawings.

1.2 APPLICATION:

A. Existing Real Time Automation Controller (PLC) is a Schweitzer SEL-2141 RTAC system.

B. The existing system senses power outages, monitors load, opens breakers, starts a diesel generator, then closes breakers to match load in a sequence of priority. If the load is high enough, it also controls the availability of on site wind turbines.

C. The new additions will include a new closed transition vacuum breaker utility main, a new branch circuit to add to the sequence of load priority, and a future on site solar array breaker. Provide all programming and equipment to integrate these new additional items into the existing Automation Controller logic sequence.

1.3 RELATED WORK SPECIFIED ELSEWHERE:

A. Basic Material & Methods – Section 26 05 00.

B. Wires & Cables – Section 26 05 19.

1.4 QUALITY ASSURANCE:

A. All installation of shall meet or exceed the following standards:

1. National Electric Code (NFPA 70) – Latest edition

2. UL listing is required

B. Manufacturers shall be engaged in the manufacturing of industry accepted wiring and materials for a period of no less than 5 years for all types and sizes required.

1.5 SUBMITTALS:

A. Submit product data for the inverter, and all control wiring.

B. Submit Wiring Shop drawings, showing equipment layout, ladder diagrams, terminal strip wiring diagrams, and block wiring diagrams. Include all input and output analog and digital signals.

C. Download existing program, add additional program components, and then submit a copy of the proposed program for review. Submittal shall be in pdf written logic format suitable for inclusion in the Owner and Maintenance maanual, plus the original program SEL file in electronic format.

PART 2 - PRODUCTS

2.1 VENDORS

A. ACCEPTABLE VENDORS: Subject to compliance with all requirements, provide products and installation through one vendor/integrator, capable of programming the Schweitzer System. The following vendors are prior approved to bid:

a. IC Tech, Inc. – Innovative Control Tecchnologies
Attn Igor Kovalenko
801-571-6740

b. Job Industrial Services Inc.
Attn Mike Cook
801-433-0901

Alternative vendors shall be considered if submitted on time prior to bid opening as per section 26 0500 and General Conditions requirements. All prior approved vendors shall be listed in approved addendum.

B. Provide products of a quality manufacturer located within the United States. Equipment made in Europe, Asia, South America, Africa, or other overseas markets are not acceptable.

C. Provide products that are listed and labeled by UL for all applications used, and for specific types, sizes and combinations of conductors and other items connected.

2.2 CONDUCTORS:

A. Provide RS-485 control cable as specified, suitable for Mod-Bus installation. The following manufacturers are preapproved:

West Penn
Belden

2.3 INVERTERS:

A. Provide DC TO AC true sine wave Inverter, 48/125 VDC input, 120 VAC output, 1000w minimum capacity, to power the existing RTAC and replace the small UPS originally specified.

Aims Power Corporation
Cotek

B. Inverter input shall match and mate with the DC source from the electric switchgear, already installed, and the new DC power source for the new switchgear. Note that these are not 12 volt systems.

C. Inverter will require a stand alone cabinet to be installed next to the RTAC cabinet. Provide proper secondary breaker or fuse protection prior to installation of wires into the RTAC system cabinet.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Install and properly terminate all RS-485 control cable on existing termination strips. Label each wire at both ends to match the shop drawing.

B. Install and anchor the new inverter cabinet adjacent to the existing cabinet. Label cabinet with engraved label.

3.2 COMMISSIONING AND TESTING:

A. Contractor shall provide a time for access and inspection of new SCADA system components for the Architect/Engineer, and the commissioning vendor. Correct all defects and flaws found prior to final termination and testing.

B. Ring out and Test all wires and verify installation. Demonstrate electrical continuity at selected connections using an electrical ohmmeter. Point to point resistance values shall not exceed 0.5 ohms. Provide additional bonding as necessary to ensure these resistance values are less than 0.5 ohms, and list results on the testing report.

C. Schedule an outage in off peak hours, including evenings, Saturday, or Sunday to fully test the operation sequence of the SCADA system. Testing shall occur only when the wind is blowing at speed high enough to generate power from the existing wind turbines, 15 to 20 mph is preferred minimum.

D. Demonstrate a simulated power outage by coordinating with the Utility and watch and time the generator start, breaker trip and transfer functions to the Engineer and owners satisfaction.

E. Provide an additional load bank of at least 500 kW to assist in loading the system to ensure proper load. Test the load when the existing load plus load bank is at least 1.5 MW. The load bank should be tied onto a priority 1 circuit switch, preferably through a step up transformer to 12470 volt wire system.Alternatively the contractor may provide several smaller load banks tied to buildings services of 208 or 480 volt around base. Do not tie load banks to single phase services.

F. Provide an additional portable generator of at least 300 kW to assist in creating on site power for the future solar breaker. Supply and provide a temporary step up transformer and wiring to provide a complete connection into the solar breaker.

G. The following is an approximate sequence of testing that shall be verified with the RTAC controller logic:

1) Turn off utility power (potentially at the Rocky Mnt Power cutouts)

2) Verify that the control logic identifies the last measured load on the new main breaker

3) Verify all breakers required to open do so and record the time delay

4) Verify time delay prior to Generator start and record value at transfer

5) Watch and verify generator start and transfer to heat up bus

6) Watch sequence and time delays of priority one, two, and three breakers

7) Identify and watch the wind generator transfer.

8) Identify and watch the future solar breaker transfer.

9) Reintroduce utility power while wind and solar temporary are both contributing power. Verify that the SCADA system identifies the return of utility power and verify count down time delay.

10) Watch closed transition and synching functions of main breaker to tie back in utility power, and then watch as generator breaker opens and generator cools down. Manually switch off the temporary generator system.

H. After all testing is completed to satisfaction of the Base personnel, Rocky Mountain Power, and Engineer, remove temporary wiring, temporary transformers, and return system to normal state. Turn in testing report with O&M manuals.

END OF SECTION

SECTION 26 05 00 – BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 WORK INCLUDED:

A. Provide all items, articles, materials, equipment, operations and/or methods listed, mentioned, shown and/or scheduled on the drawings and/or in these specifications, including all labor, services, permits, fees, utility charges, and incidentals necessary and required to perform and complete the electrical work described in this Division. Apply for all permits early in the project to avoid problems due to code revisions.

B. See the contract conditions (general and supplementary) and Division 1 for requirements concerning this Division including, but not limited to, submittals, shop drawings, substitution requests, change orders, maintenance manuals, record drawings, coordination, permits, record documents and guarantees.

C. Division 26 Contractor shall be responsible for all work indicated by divisions 26, 27, 28, and the electrical portions of 33 within the drawings and specifications. Any work indicated by Division 16 shall be provided and installed by the Division 26 Contractor.

1.2 RELATED WORK SPECIFIED ELSEWHERE:

A. Mechanical equipment motors to be furnished under another Division but connected under this Division. Starters to be mounted and connected by this Division, but furnished by another Division unless otherwise noted on the electrical drawings. Motor control centers shall be furnished and installed under this Division of the work. Verify and coordinate all equipment locations and electrical characteristics with other trades involved in the work. Coordination shall be done prior to rough-in or ordering equipment.

B. Control wiring for mechanical equipment beyond provisions shown on the Electrical Drawings shall be performed under another Division of the work.

1.3 QUALITY ASSURANCE:

A. Do all work in accordance with regulations of serving electric utility, telephone utility, cable TV utility, National Electrical Code, state and local codes and amendments, National Fire Codes, and all other applicable codes. Where applicable, Owners Design Standards have been incorporated into the design, the contractor shall refer to these Standards for additional clarification.

B.

1.4 PROJECT CONDITIONS:

A. The Contractor shall inspect the job site prior to bidding and familiarize himself with existing conditions which will affect the work. Prior to start of work, obtain "As built", "Record", or other Drawings showing existing underground utilities.

B. Electrical drawings are diagrammatic indicating approximate location of outlets, lighting fixtures, electrical equipment, etc. Consult the Architectural, Structural, and Mechanical Drawings to avoid conflicts with equipment, structural members, etc. When required make all deviations from Drawings to make the work conform to the building as constructed, and to related work of others. Minor relocations ordered prior to installation may be made without added cost to Owner.

C. Call to the attention of the Architect any error, omission, conflict or discrepancy in Drawings and/or Specifications. Do not proceed with any questionable items of work until clarification of same has been made.

D. Under no conditions are beams, girders, footings or columns to be cut for electrical items unless so shown on Drawings or written approval obtained from the Architect.

E. Verify the physical dimensions of each item of electrical equipment to fit the available space and promptly notify the Architect prior to roughing-in if conflicts appear. Coordination of equipment to the available space and to the access routes through the construction shall be the Contractor's responsibility.

1.5 SHOP DRAWINGS:

A. Prior to ordering equipment, and prior to Contractor’s first application for payment, the Contractor shall, within 14 days after award of this work, submit complete shop drawings, electronic PDF copy with PDF index tabs, or six (6) hard copies neatly bound in 3-ring binder form, with indexed tabs, to the Architect, of materials and equipment he proposes to furnish. It is preferred that all sections be submitted at once, however, in the event that one or more sections need approvals quickly and others are not prepared yet, the Engineer will agree to review the individual section submittals needing immediate approval. However, each individual submittal section must be complete and remaining submittals that are not a rush shall be submitted all in one package as quickly as possible. Submitting individual sections over many weeks/months will not be tolerated.

B. List shall bear Contractor’s stamp, signature or other means to show that he has inspected same and certified that submitted material is correct in regard to quantity, size, dimension, quality and is coordinated with the Contract Documents.

C. See individual sections within this Division for products requiring submittal.

D. Each shop drawing submittal shall be prepared by the manufacturer, and shall clearly show manufacturer’s name, catalog numbers, pictures, details, layout, type, size, rating, style, and all options identified in a permanent fashion. Specific items or options shall be permanently marked on sheets containing more than one option – do not rely on the Engineer to mark options. Yellow highlight will not be an acceptable means of marking.

E. Large equipment drawings such as UPS systems, generators, transformers, switchboards, and similar large equipment shall include the size, weight, seismic rating, emissions data, elevation, and wiring diagrams in addition to the product data.

F. Some sections of this Division may require shop drawings prepared on full size floor plans in AutoCAD or other CAD software. Where required, contact the Architect for the latest version of the electronic plans and match the size and scale of the construction drawings. Drawings delivered to the contractor from the Architect/Engineer may not include addenda changes. Contractor shall only use electronic plans for purposes of the

construction on this job, and not for any other use or reuse. Add any required addenda items prior to finishing shop drawings and submittals.

G. Provide complete materials (all materials) list at the beginning of each tabbed section showing “Submittal Number”, “Specification Section”, “Material Item”, “Manufacturer’s Name and Catalog Number”, and all pertinent data.

H. Provide samples where required in individual sections of this Division.

I. Contractor agrees that Shop Drawing Submittals processed by the Architect are not Change Orders; that the purpose of Shop Drawing Submittals by the Contractor is to demonstrate to the Architect that the Contractor understands the design concept, that they demonstrate their understanding by indicating which equipment and material they intend to furnish and install and by detailing the fabrication and installation methods they intend to use.

J. Contractor further agrees that if deviations, discrepancies or conflicts between Shop Drawings and Specifications are discovered either prior to or after Shop Drawing Submittals are processed by the Architect/Engineer, the design Drawings and Specifications shall control and shall be followed.

PART 2 - PRODUCTS

2.1 MATERIALS:

A. All materials shall be new and bear manufacturer's name, model number, electrical characteristics and other identification. All equipment to be U.L. approved or listed by another testing agency approved by authorities having jurisdiction.

B. Material and equipment shall be standard product of manufacturer regularly engaged in production of similar material for at least five years (unless specifically exempted) and shall be manufacturer's latest design.

C. If the description of a product is in conflict with the product as specified in the catalog number, the description shall generally take precedence. Contact the Architect for clarification if this occurs.

All equipment must be rated and certified for the appropriate seismic design category or seismic use group for the installed geographical location. For essential or life safety equipment, provide an additional seismic factor of 1.5..

2.2 DISCONNECTS:

A. Safety and disconnect switches to be Heavy duty quick-make, quick-break, dual rated, lockable, and of such electrical characteristics as required for the load served. Switches to have defeatable cover interlock.

B. Fuse clips shall accept Class R or Class L fuses if required. Motor rated toggle switches equal to Square D Class 2510, type F with thermal overloads may be used as motor disconnects in dry locations.

C. Disconnect switches required by code shall be installed whether or not specifically shown on the Drawings.

D. Disconnect switches for refrigeration equipment and multiple motor HVAC equipment shall be fusible type.

E. Safety and disconnect switches (fuse, non-fuse or circuit-breaker type) to be of same manufacturer as switchgear and panelboards.

F. Elevator Power Module (EPM):

1. Rated as indicated on the plans, 600 VAC and 200,000 amps RMS interrupting current.

2. Features shall include, but are not limited to 120V shunt trip capabilities, control power transformer and terminal bock, ground lug, fire safety interface relay, and status indicating pilot lights.

3. Provide with Class J fuses, sized per elevator manufacturer's recommendations.

4. Power Module shall be equal to Bussmann PS1 series, Ferraz Shawmut or approved.

2.3 FUSES:

A. Provide fuses as indicated on the drawings, sized per NEC, or as required by the equipment manufacturer, whichever provides maximum protection, for a fully operational system.

B. All fuses shall be furnished of the same manufacturer.

C. All fuses shall be installed by the electrical contractor at job-site and only when equipment is to be energized. Fuses shall not be installed during shipment.

D. All fuses to be 200,000 AIC, Current-limiting, U.L., Time Delay, Dual-element Type as follows:

For feeders 601 Amps to 6000 Amps:
Class L, KRP-C, KLPC, & A4BQ
For feeders 600 Amps and less:
Class RKk-1 for 600 volt; LPS-RK, LLS-RK, & A6D-R
Class RK-1 for 250 volt; LPN-RK, LLN-RK, & A2D-R
Class J; JHC, JTD, & AJT
For motor circuits beyond the main and sub distribution boards, 600 volt and below:
Class RK-5 for 600 volt; FRS-R, FLS-R, & TRS-R
Class RK-5 for 250 volt; FRN-R, FLN-R, & TR-R

E. SPARE PARTS: Provide 10% spare fuses, but not less than 3 of any one size and type.

F. Provide Spare Fuse Cabinet(s), #SFC, #LSFC, & ATFC as required. Install cabinet(s) in Main Electrical Room.

G. Approved Manufacturers, with catalog numbers listed in order: Bussman, Littelfuse, Ferraz Shawmut.

H. If the electrical contractor wishes to furnish materials other than those specified, a written request, along with a complete short circuit and selective coordination study, shall be submitted to the engineer for evaluation at least 8 days prior to the bid date. If the engineer's evaluation indicates acceptance, a written addendum will be issued listing the other acceptable manufacturer.

2.4 BOXES:

A. Outlet and junction boxes shall be sized in accordance with code requirements or as noted on the drawings.

B. Unless otherwise specified or shown on the drawings, all outlet boxes for new work shall be galvanized steel knockout, outlet boxes. Gangable boxes are not acceptable. Outlet boxes shall not be smaller than 4" square and 1-1/2 inches in depth, unless otherwise noted. All outlet box covers, rings, or other fittings shall be galvanized. Boxes which are exposed to the weather shall be cast metal. Outlet boxes for phone and data outlets shall be 2.5" deep boxes.

C. Outlet boxes shall be designed for the intended use, and shall be installed flush with finish surface lines or not more than 1/8 inch back and shall be level and plumb. Long screws with spaces or shims for mounting devices are not acceptable. No combustible materials shall be exposed to wiring at outlets.

D. Outlet boxes on opposite sides of fire or sound isolating partitions shall have a minimum horizontal separation of 24". Back to back boxes are not permitted in any walls.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION METHODS:

A. All items, articles, materials, and equipment specified under this Division shall be installed per the manufacturer's installation instructions. Where the manufacturer's instructions are in conflict with the directions provided elsewhere in this Contract, the Engineer shall be notified prior to beginning rough-in.

B. Cutting or notching shall be kept to an absolute minimum and done when, and in a method approved by the Architect. Patch and correct finished surfaces damaged by electrical work.

C. Relays, panels, cabinets and equipment shall be level and plumb and installed parallel with structural building lines. All equipment and enclosures shall fit neatly without gaps, openings, or distortions. Provide approved devices for closing all unused openings.

D. Arrange circuit wiring as shown on the Drawings and do not alter or combine runs or homeruns without the specific approval of the Architect. Feeder runs shall not be recombined or altered.

E. Contactors, transformers, starters and similar noise producing devices shall not be placed on walls which are common to occupied space.

F. Ballasts, contactors, starters, transformers and like equipment which are found to be noticeably noisier than other similar equipment on the project will be deemed defective and shall be replaced.

G. In general, the mounting heights shall be as noted on the Drawings, or as listed below, the Architectural Interior Elevations and drawing notes taking precedence. Where no heights are indicated, request clarification from the Architect. Consult the Architectural, Mechanical and Structural drawings to avoid conflicts prior to roughing-in and for exact locations. All dimensions are to the top of the back box or device whichever is higher. Lighting dimensions are to the bottom of suspended fixtures and center of wall mounted fixtures unless otherwise noted.

Light Switches	48 inches to center
Convenience Receptacles	18 inches to center
Data/Telephone Outlets	18 inches to center
Receptacles and Outlets Over Counters	10 inches above counter or 5 inches above Backsplash to top, whichever is greater.
Panelboard	72 inches to top
Disconnects and Motor Controllers	72 inches to top
FACP and NAC panels	72 inches to top
Fire Alarm Signals	96 inches to top (but at least 6" below ceiling)
Fire Call Stations	48 inches center
Fire Alarm Annunciator	66 inches to top

H. Where raceways penetrate floors, ceilings, ducts, chases, and fire walls, provide fire stopping to maintain integrity of the fire assembly. Firestopping method shall be approved by the Code Authority having jurisdiction.

I. All materials and equipment installed under this work shall be properly and adequately supported from the building structure except where ceiling construction or other provisions are specifically designed to support them. Support systems shall provide a safety factor of four. This shall apply to chains, hangers, anchors, clamps, screws, structural iron, and all other hardware and appurtenances associated with the support system.

J. Rough-in for communications outlets for phone and data systems shall consist of a 4" square deep (4SD) box with a single gang mud ring. Provide a .75" conduit for wall phones and a 1” conduit for combination voice and data outlets to an accessible ceiling space. Conduit shall be terminated above the ceiling in a bushing and a pull string installed.

K. Maintain the following minimum separations from voice and data cables. Power conduit - 12", transformers and motors - 40", fluorescent lighting - 12". Coordinate with the voice and data installer to assure these separations are met.

3.2 LOW VOLTAGE WIRING METHODS:

A. Provide Conduit homeruns complete for all low voltage systems.

3.3 LABELING:

A. Clearly and properly label the complete electrical system to indicate the loads served or the function of each item of equipment provided under this work.

B. Permanent Engraved nameplates: shall be 1/16 inch thick, laminated three-ply plastic, center-ply white, outer-ply black (for normal power) or red (for emergency power) or orange (for UPS power) "Lamicoid" or equal. Letters shall be formed by engraving outer

colored ply, exposing white center-ply, and shall be a minimum of 5/8 inch high. Nameplates shall be secured with screws or pop rivets.

C. Provide permanent engraved nameplates for the equipment listed below as well as all other similar equipment; refer to each section for specific labeling requirements:

1. Manholes
2. Medium Voltage Switches, Switchgear and Sectionalizing Cabinets
3. Service Equipment, including the maximum available fault current and date calculated as provided by Engineer
4. Switchboards and Panelboards
5. Transformers, UPS's, and Surge Protection Devices
6. Motor Control Centers (MCC), Motor Controllers, Variable Frequency Drives (VFD), Safety Disconnects
7. Generators and Automatic Transfer Switches
8. Electrical Contactors and Relays
9. Lighting Control Panels, Lighting Contactor Panels, Dimming Panels, and Timeclocks
10. Security Panels and power supplies
11. Fire Alarm Control Panels (FACP) and Fire Alarm Notification Appliance Circuit Panels (NAC)
12. Other similar electrical devices and equipment

D. Self-Adhesive Labels: shall have self-adhesive "P-Touch" or equivalent sticky backs, black lettering with a clear (see through) background.

E. Provide self-adhesive labels for the devices and equipment listed below as well as all other similar equipment; each label shall list the applicable circuit number feeding the device and devices fed from Emergency or UPS power shall also list "EMERGENCY" or "UPS" as applicable next to the circuit number (for example, a receptacle fed from circuit 2 in panel 1P1 would read "1P1-2" on the label):

1. Thermal Switches and Manual Starters
2. Power outlet receptacles
3. Light Switches, Wall Mount Occupancy Sensors, and Wall Mount timeswitches
4. Dimming Switches and Wall Mount Dimming controllers
5. Fire alarm initiation devices (smoke detectors, heat detectors, pull stations, etc.)

6. Fire alarm notification devices (horn/strobes, etc.)

F. For Service switchboards, panelboards, and/or disconnecting means, provide a permanent engraved label indicating maximum available fault current as calculated by the Engineer. Include the date calculation was made.

G. Where existing service entrance components are modified, including where conductors are increased in size, or the service transformer or service disconnecting means is replaced or increased in size, provide a new permanent engraved label on each service switchboard, panelboard, and/or disconnecting means with required information as indicated by the National Electrical Code.

H. Provide neat and clearly legible handwritten labeling using a permanent “Sharpie” or equivalent chisel tip black marker for all junction boxes containing power and fire alarm wiring. Label each junction box with the applicable circuit number(s) for the cables contained within each junction box in a location and large enough to be clearly visible from the floor.

I. Provide a laminated copy of the electrical one line diagram(s), size of sheets as required to be clearly visible. Permanently mount within main electrical room, coordinate final location with architect.

J. Where changes are made in existing panels, distribution boards, etc., provide new labeling and schedules to accurately reflect the changes.

K. Provide typewritten branch panel schedules with protective clear, transparent covers accounting for every breaker installed. Use actual room designations assigned by name or number near completion of the work, and not the designations shown on drawings.

L. Provide a permanent engraved label or include with the panel schedule information indicating the conductor insulation color for: (1) all ungrounded conductors (2) grounded conductor (3) equipment grounding conductor. This shall be documented at each panelboard and switchboard in a readily visible location; refer to Wires & Cables section 26 05 19 for conductor color coding.

M. Identify branch panels with engraved nameplate corresponding with distribution panel labeling. Mount labels inside door for flush panels, and on the face of the door for surface panels. No brand labels or other marking shall be on the outside of the panels. Where changes are made in existing panels, distribution boards, etc., provide new labeling and schedules to accurately reflect the changes.

3.4 SAFETY:

A. The Engineer has not been retained or compensated to provide design and construction review services relating to the Contractor's safety precautions or to means, methods, techniques, sequences or procedures required for the contractor to perform the work.

3.5 DEMOLITION:

A. It is the intent of these specifications to require the contractor to make all necessary adjustments to the electrical system, required to meet code, and accommodate installation of the new and remodeled work.

B. Remove all existing fixtures, clocks, switches, receptacles, raceways, and other electrical equipment and devices and associated wiring from walls, ceilings, floors, and other surfaces scheduled for remodeling, relocation, or demolition unless specifically shown as retained or relocated on the drawings. If existing walls, ceiling, floors, etc. are moved, extend existing devices, fixtures, and circuiting to the new location.

C. Disconnect all existing mechanical equipment scheduled for removal or relocation. See mechanical drawings for scope of work. Remove abandoned raceways and cables. Relabel panels and motor control centers to reflect changes.

D. If existing junction boxes will be made inaccessible, or if abandoned outlets serve as feed through boxes for other existing electrical equipment which is being retained, new conduit and wire shall be provided to bypass the abandoned outlets. If existing conduits pass through or are mounted on partitions or ceilings which are being removed or remodeled, new conduit and wire shall be provided to route around the ceiling or wall and maintain service to the existing load.

E. Extend circuiting and devices in all existing walls to be furred out.

F. Locations of items shown on the drawings as existing are partially based on as-built and other drawings which may contain errors. The Contractor shall verify the correctness of the information shown prior to bidding and provide such labor and material as is necessary to accomplish the intent of the contract documents. The plans may show some demolition conditions, but are not intended to show all of them.

G. All materials accumulated during the demolition process are the Owners property and shall be removed from the job site and delivered to an Owner storage facility as directed by the Owner. If owner does not wish to salvage materials, contractor shall remove from jobsite and dispose, or recycle materials at contractor’s discretion, in a lawful manner.

H. Where changes are made in existing panels, distribution boards, etc., provide new labeling and schedules to accurately reflect the changes.

I. Demolish and dispose of hazardous materials in a lawful manner, such as PCB containing transformers or ballasts, mercury containing lamps, or materials containing lead. All costs for proper disposal shall be paid by the contractor unless specified elsewhere in the general conditions.

J. Test all demolished power poles for the following wood treatments: creosote, pentachlorophenol, and chromated copper arsenate. Provide test results in the O&M manuals. Recycle poles that are in good shape according to materials and wood treatment as available. Dispose of all other poles in a lawful manner and according to the wood treatment materials.

K. Test all demolished transformers for oil containing PCB. Provide test results in the O&M manuals. Recycle where possible, and dispose of all transformers in a lawful manner.

3.6 POWER INTERRUPTIONS:

A. Keep outages to occupied areas to a minimum and prearrange all outages with the Owner's representative and utilities involved. Requests for outages shall state the specific dates and hours and the maximum durations, with the outages kept to these specified times. When power interruptions will last longer than 5 minutes and cover more

than 10% of the building, or affect public areas, they shall be performed on the weekends between 1 and 5 AM.

B. Contractor shall coordinate with the Owner so that work can be scheduled not to interrupt operations, normal activities, building access, etc. Coordinate work with other crafts for proper scheduling.

C. No circuits shall be turned off without prior approval from owner. Coordinate with the Owner any interruptions which affect the operation of the remaining portions of the facility.

D. This contractor will be liable for any damages resulting from unscheduled outages or for those not confined to the preapproved times. Include all costs for overtime labor as necessary to maintain electrical services in the initial bid proposal. Temporary wiring and facilities, if used, shall be removed and the site left clean before final acceptance. Requests for outages must be submitted at least (5) days prior to intended shutdown time.

E. Include in bid cost of minimum temporary power for Fire Alarm System, Security, Telephone/Data equipment and any other equipment designated by Owner, during time when primary building power has been interrupted.

3.7 GROUNDING:

A. Ground all electric equipment, raceways and enclosures in accordance with code rules and established safety practices. Provide a single main grounding point where grounding conductors from the Grounding Electrode System ground rods, ground grids, water pipes, main switchgear, etc. may be terminated.

B. Concrete encased UFER grounds shall be 2/0 Bare Copper, no less than 40 feet in length. Utilizing rebar for a UFER, although allowed by code, is not acceptable. Bare Copper conductors shall be placed no closer than two inches of the bottom of an exterior wall footing and there shall be no plastic sheeting or other insulating material placed between the footing and earth. Bond to re-bar at minimum 10' intervals.

C. Grounds shall be installed where accessible for future inspection and servicing. Where ground connections are made underground or in inaccessible locations, they shall be made using an exothermic weld process, Cadweld or equivalent, or Ampact pressure connectors.

D. Install grounding conductors in approved metallic raceways unless specifically shown or specified otherwise. Bond at each end and at all intervening boxes and enclosures between the service equipment and grounding electrode.

E. No. 8 and smaller grounding conductors shall have green insulation. No. 6 and larger shall be marked with green colored tape at each end and at every box, panel, switchboard, or point where conductor is accessible.

F. All isolated ground buses shall be used only for conductors from isolated ground receptacles. Do not bond conduit or enclosures to isolated ground buses. All isolated ground conductors shall be run back to the main ground point for the separately derived system which serves them.

3.8 TVSS (Transient Voltage Surge Suppression) INSTALLATIONS

A. When TVSS units are specified, they are to be shipped with complete installation instructions which are to be followed in detail. The manufacturer's representative is always to be contacted and is to supervise the TVSS installation.

B. Supplemental installation information is as follows:

1. Use the breaker space closest to the neutral bus. Nipple the suppressor to the panel where the suppressor can be installed so as to keep both the hot leads and the neutral lead as short and straight as possible from the suppressor to the breakers and the neutral bus.

2. The best performance is achieved with the shortest leads and neutral. All efforts within the code should be used to minimize the lead lengths. Ideally the leads should be less than eight inches long. Each inch of lead above six inches will add approximately 20 volts to the quoted let-through voltage. Cut the leads down to the shortest size that will allow installation.

3. If the neutral bus is out of reach of the leads, then a #4 AWG conductor is to be run from the remote neutral bus to a lug near the suppressor, and the lead from the suppressor should be cut as short as possible.

4. The ground is to be connected to the case of the panel (equipment ground only). Do not connect the suppressor ground wire to an isolated ground (IG) bus.

3.9 EQUIPMENT CONNECTIONS:

A. The location and method for connecting to each item of equipment shall be verified prior to roughing-in. The voltage and phase of each item of equipment shall be checked before connecting. Motor rotations shall be made in the proper direction. Pump motors are not to be test run until liquid is in the system and proper lubrication to all bearings in unit is checked.

B. Conduit, wire and circuit breaker sizes for mechanical, elevator and similar equipment are based on the equipment ratings of one manufacturer. The equipment actually furnished may have entirely different electrical characteristics. Conduit, wire, circuit breakers, disconnects, etc. shall not be ordered or installed until exact electrical requirements are obtained. Responsibility for this coordination rests with the Contractor.

3.10 SEISMIC BRACING:

A. Furnish and install all seismic bracing of equipment, feeders, lighting fixtures, and other electrical items in accordance with prevailing codes. Refer to ASCE 7-10, section 13.3 and 13.6 for calculation methods. Provide and submit the required designs, calculations, certifications, and stamped drawings to the authority having jurisdiction and obtain their approval prior to installation or fabrication.

B. Where conduit, cable trays, or busducts are attached to structures where they cross a seismic isolation interface, the electrical components shall be designed to accommodate the seismic relative displacement.

3.11 PAINTING:

A. All electrical equipment and conduit exposed in finished areas and on exterior walls are to be painted to match surrounding surfaces.

B. Contractor shall coordinate the timing of painting requirements.

C. Refer to Architectural specifications for methods and materials.

3.12 PROJECT RECORD DOCUMENTS:

A. Maintenance of Documents:

1. Maintain at Jobsite, One Record Copy of: Contract Drawings, Specifications, Addenda, Reviewed Shop Drawings, Change Orders, Other Modifications to Contract and Field Test Records.

2. Keep apart from documents used for construction.

3. Keep documents available at all times for inspection by Architect.

B. Recording:

1. Label each document "PROJECT RECORD."

2. Keep record documents current. Do not permanently conceal any work until required information has been recorded.

3. Contract Drawings, legibly mark to record actual construction; including but not limited to the following:

a. Depths of various elements; locations of underground items, with dimensions to building walls and corners; changes of dimensions and details; changes made by Addendum, Field Orders or Change Order.

b. Specifications and Addenda; legibly mark each Section to record changes made by Addendum, Field Order or Change Order.

C. As-Built Submittals:

1. Label each document "PROJECT RECORD."

2. Keep record documents current. Do not permanently conceal any work until required information has been recorded.

3. Contract Drawings, legibly mark to record actual construction; including but not limited to the following:

a. Depths of various elements; locations of underground items, with dimensions to building walls and corners; changes of dimensions and details; changes made by Addendum, Field Orders or Change Order.

b. Specifications and Addenda; legibly mark each Section to record changes

made by Addendum, Field Order or Change Order.

4. At completion of project, transfer changes, addenda items, variations from drawings, exact routes of all feeders and service conduits, and locations of stubbed conduits to clean new prints and specifications which will be supplied by the Architect and deliver to the Architect as "As-reported Record" drawings. Include dimensions to all buried or concealed conduits to permanent structures.

5. Deliver the revised files on CD or DVD disks, both in AutoCAD (.dwg) and Acrobat Reader (.pdf) formats, together with 1 set of reproducible prints, to Architect as "As-reported Record" drawings.

D. Operation and Maintenance Manuals

1. At completion of project, prepare Operation and Maintenance Manuals with operation and Maintenance Data, contractors warranties, and copies of approved electrical permits. Include corrected copies of original submittals and shop drawings.

2. See Division 1 for additional requirements.

3.13 WARRANTIES:

A. Provide a minimum 1 year warranty on all electrical equipment, devices, labor, and work by Division 26 whether specified or not.

B. Provide warranties greater than 1 year as specified in other sections where stated. The warranty requirement most stringent shall be used where conflicts arise.

C. The systems listed below require warranties exceeding the minimum warranty:

1. Surge Protective Devices (TVSS); 5 years refer to Section – 26 43 00

2. Lighting; 5 years for ballasts refer to Section – 26 51 00

D. Provide copies of all warranties to the owner upon completion of the project.

3.14 COMPLETION:

A. Complete each system as shown or specified herein and place in operation except where only roughing-in or partial systems are called for. Each system shall be tested and left in proper operation free of faults, shorts or unintentional grounds. Demonstrate system in the presence of the Architect, the Owner or their representative when requested.

3.15 FINAL OBSERVATION:

A. Contractor shall submit written certification that:

1. Contract Documents have been reviewed.

2. Contractor has inspected Project for compliance with Contract Documents.

3. Work has been completed in accordance with Contract Documents.

4. Equipment and Systems have been tested and are operational.

5. Project is completed and ready for final inspection.

B. Architect will make final inspection as soon as possible after receipt of Certification.

C. Should Architect consider that work is finally complete in accordance with Contract Document requirements, Contractor shall make Contract Closeout submittals.

D. Should Architect consider that work is not finally complete:

1. He will so notify Contractor, stating reasons.

2. Contractor shall take immediate steps to remedy deficiencies, and send second written notice to Architect certifying that work is complete.

3. Architect will re-inspect work.

E. The Architect will make two final inspections. The first will determine deficiencies and errors in the work and the second will determine whether or not the noted deficiencies and errors have been satisfactorily corrected.

F. If additional inspections are required because of the Contractor's failure to complete the deficiencies and errors prior to the second inspection, costs for the successive inspections will be back-charged to the Contractor by the Owner, who, in turn, will reimburse the Architect. Charges will be based as follows:

1. Architect time at current billing rates.

2. Travel time, and all other expenses incurred in making inspections.

G. Contractor to provide one (1) journeyman, tools, meters, instruments and other test equipment required by Architect. Contractor to remove and replace trims, covers, fixtures, etc., for Architect to review and test materials, systems, methods and workmanship. (Example: Removing switchboard and panel covers to take voltage/amp readings, review connections and wire size, etc.)

END OF SECTION

SECTION 26 05 13 – WIRES AND CABLES OVER 600 VOLTS

PART 1 - GENERAL

1.1 WORK INCLUDED:

A. Provide all medium voltage 15 kV wires and cables as herein specified and shown on the associated drawings.

B. Provide all required terminations, splices, raceway, mounting equipment as required for a complete medium voltage wiring system.

C. Provide all required testing and testing reports as herein specified and shown on the associated drawings.

1.2 RELATED WORK SPECIFIED ELSEWHERE:

A. Basic Materials and Methods – Section 26 05 00.

B. Raceways – Section 26 05 33.

1.3 QUALITY ASSURANCE:

A. All wire and cable shall meet or exceed the following standards:

1. ASTM-B series specifications
2. Insulated Cable Engineers Association (ICEA) ICEA S-94-649
3. NEMA WC74
4. AEIC
5. U.L. listed.
6. National Electric Code (NFPA 70) – Latest edition

B. Testing shall be by High Potential DC and/or Partial Discharge testing in accordance with the following standards.

1. NETA 7.3.3 AND Table 100.6
2. ANSI/IEEE 400
3. ICEA S-93-639/NEMA WC74-2000

4. ANSI/ICEA S-94-659-2000

5. ANSI/ICEA S-97-682-2000

C. Manufacturer's shall be engaged in the manufacturing of industry accepted quality wires and cables for a period of no less than 5 years for all types and sizes required.

D. Each reel of cable furnished shall be newly manufactured (no more than 12 months old) and shall bear a tag containing the name of manufacturer, NEC designation and year of manufacture

1.4 SUBMITTALS:

A. Submit complete and descriptive shop drawings indicating compliance with the specifications herein.

B. Furnish certified test reports of all applicable factory tests per AEIC and IPCEA at time of delivery. A copy of the original X-Y plot showing discharge levels shall be submitted at time of delivery. Contractor shall retain copies for inclusion in the O&M manuals.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. Subject to the final approval and acceptance by the A/E and Owner, provide cable products from one of the following manufacturers:

1. General Cable

2. Okonite

3. Kerite

B. Subject to the final approval and acceptance by the A/E and Owner, provide molded product deadbreak and loadbreak termination products from one of the following manufacturers:

1. Thomas and Betts Elastimold

2. Cooper

C. Subject to the final approval and acceptance by the A/E and Owner, provide splice products from one of the following manufacturers:

1. Raychem

2. 3M

3. Cooper

4. Thomas and Betts Elastimold

D. Requests for substitution of other products will be considered if submitted in accordance with the General Conditions, Division 01, and Section 26 05 00 to the A/E office within (8) business days prior to the bid opening day.

2.2 MEDIUM VOLTAGE WIRES & CABLES:

A. Provide single conductor cables only, (3) conductor cables are not allowed.

B. Conductor shall be stranded, aluminum, covered with an extruded semi-conducting EPR strand screen, 220 mil ethylene propylene rubber insulation extruded EPR semi-conducting insulation screen, 5 mil bare copper shielding tape with 12-1/2% minimum overlap, with 80 mil flame retardant PVC jacket overall, 15kV type, ungrounded neutral, 133% insulation level.

C. Conductor strand screen, insulation and insulation screen shall be extruded simultaneously (triple tandem extrusion). Color differentiation shall be accomplished by using black semi-conducting layers and red insulation.

2.3 MEDIUM VOLTAGE TERMINATIONS:

A. Provide terminations as shown on the associated drawings and as required for the complete installation of the cable system.

B. Terminations at 600 amp switched ways of VFI switches shall be 600 amp deadbreak molded products. Terminations at 200 amp load taps at VFI switches shall be 200 amp loadbreak molded products.

C. Terminations at existing switches shall be as required to terminate to the existing switch and shall match the existing switch termination type, confirm termination type for all existing switches prior to submittals to ensure compatibility.

2.4 MEDIUM VOLTAGE SPLICES:

A. Provide splices as shown on the associated drawings and as required for installation of the cable based on the conditions of the installation and other factors such as length of remaining cable on reels.

B. Provide splices only in accessible areas such as at switches, sectionalizing cabinets, manholes, or transformers.

C. All medium voltage splices shall be molded product with an ampere rating greater than or equal to the conductors that it is splicing.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION METHODS:

A. Cable shall be installed in rigid metallic conduit as shown on drawings. All conduits shall have a minimum bending radius of five feet.

B. Cables shall loop all manholes they enter or exit a minimum of (1) complete 360 degree loop. Cables installed directly through a manhole are not acceptable.

C. Terminate cable in stress cones and/or load break ells at transformers and pad mounted switchgear as applicable.

D. Splices shall not be allowed in raceway. Splices in vaults shall be racked to vault walls on porcelain insulators.

E. All terminations shall be taped and wrapped per manufacturer's instructions and industry standards

F. All medium voltage cabling within manholes, vaults, electrical rooms and other similar exposed areas shall be fire taped per manufacturer’s instructions and industry standards for the entire length of cable within the space.

G. Feeders within manholes shall be color coded, phase 1 Red, phase 2 Yellow, phase 3 Blue.

E. Only individuals with medium voltage training/experience shall perform the splicing and terminations of the medium voltage cable.

3.2 LABELING:

A. Provide a 1/16” thick x 2” tall x 3” wide laminated three-ply plastic, center-ply black, outer-ply yellow “Lamicoid” or equal. Letters shall be formed by engraving outer yellow ply to expose black lettering. Lettering shall be a minimum of ½” high. Attach label by drilling a small hole in one corner of the label and affixing the label to the cable with the use of wire-ties or equivalent.

B. Labels shall be provided for each cable at the following locations:

1. In the manhole or vault within 12” to 24” of where the cable enters and exits the manhole or vault where easily visible.

2. Within approximately 36” of termination on each switch or transformer where visible.

3. Each individual phase shall be provided with it’s own label at the required locations.

C. Label information shall be coordinated with the Owner prior to creation of labels and will include at minimum: Feeder name (for example - F72), phase (for example - Phase 1), cable construction type (for example – EPR), cable size (for example #500) and date of cable installation (for example - 01/01/2010).

COMMISSIONING AND TESTING: HIGH POTENTIAL DC TESTING (NEW CABLES ONLY):

D. All Testing shall be provided by an independent subcontractor to the Electrician.

E. Test the insulations of the installed cables by standard high potential methods with DC voltages.

F. Exercise suitable and adequate safety measures prior to, during and after the high potential tests including placing warning signs and preventing people and equipment from being exposed to the test voltages. Prior to applying the test voltages to the cables, disconnect all equipment that might be damaged by the test voltages.

G. Test cables after all terminations and splices are completed. Where cable terminations are seperable, or where installed switch allows isolation, test each section independently.

H. Increase and decrease the test voltages on the cables (between the voltage levels at which the test readings are made) at a rate of not more than 200 volts per second. Monitor the testing equipment closely and stop applying the test voltages when the equipment indicates that the leakage currents are increasing excessively.

I. Where weak points are detected in the new cables, eliminate the weak points and replace the cables.

J. Do not test existing cables with high potential DC method. Use high frequency partial discharge testing for existing cables.

K. Test voltages shall be maintained at each step for the full recommended time (usually 15 minutes). Exception will be the maximum test voltage. Maintain the maximum test voltage for five minutes for each test.

L. Read and record the test voltages and leakage currents for the cables being tested at approximately 4000 volt intervals, starting and finishing with zero test voltages. Allow the charging currents to diminish before reading the meter so that correct values can be determined for the leakage currents.

M. Plot curves for the test voltages and leakage currents on a separate graph for each test. Use log-log graph paper with time and voltage along the horizontal axis and current along the vertical axis, one curve for current versus voltage, and one curve for current versus time.

N. Submit four certified copies of each of the graphs in O&M manuals to the Engineer, with adequate information shown for identifying the cable locations, types, voltage ratings and sizes.

3.3 COMMISSIONING AND TESTING: NONDAMAGING HIGH FREQUENCY PARTIAL DISCHARGE TESTING

(EXISTING CABLES OR COMBINATION NEW/EXISTING CABLES):

A. All Testing shall be provided by an independent specialty subcontractor to the Electrician. The following vendors are prior approved to provide this service:

1. Emerson (formerly Electrotest, Inc.)

2. Prior approved alternate.

B. Test the insulations of the installed cables while energized by imposing high frequency signal and analyzing the reflected result by computer. Provide temporary power necessary to run test.

C. Exercise suitable and adequate safety measures prior to, during and after the tests including placing warning signs and preventing people and equipment from being exposed to high voltages.

D. Testing of existing cables shall be limited to those cables that are spliced and extended, and those cable segments that are spliced onto new or existing switches.

E. Where weak points are detected in the existing cables, notify the Engineer accordingly. The Engineer will determine what should be done about defective existing cables.

F. Plot graphic description of test frequencies and analyzed results report indicating one of three recommendations:

a. Green: existing cable is good

b. Yellow: existing cable is marginal. Retest within two years.

c. Red: Existing cable is in imminent danger of failure. Recommend replacement.

G. Submit four certified copies of each of the graphs in O&M manuals to the Engineer, with adequate information shown for identifying the cable locations, types, voltage ratings and sizes.

3.4 WARRANTY:

A. Cable shall carry a two-year warranty after shipment.

B. General warranty included in General Conditions Section shall apply to installation and other products used under this section.

END OF SECTION

SECTION 26 05 19 – WIRES & CABLES (600V)

PART 1 - GENERAL

1.1 WORK INCLUDED:

A. Provide all wires and cables as herein specified and shown on the associated drawings for service conductors, feeder conductors and branch circuit conductors.

1.2 RELATED WORK SPECIFIED ELSEWHERE:

A. Basic Material & Methods – Section 26 05 00.

B. Raceways – Section 26 05 33.

1.3 QUALITY ASSURANCE:

A. All wire and cable shall meet or exceed the following standards:

1. ASTM-B series specifications

2. ICEA S-61-402/NEMA WC 5 - Thermoplastic insulated cables 0-2000 volt

3. UL Standard 62 and 83 – Thermoplastic insulated cable

4. UL VW-1 Flame Test for sizes #12 through #1

5. National Electric Code (NFPA 70) – Latest edition

B. Manufacturer's shall be engaged in the manufacturing of industry accepted quality wires and cables for a period of no less than 5 years for all types and sizes required.

1.4 SUBMITTALS:

A. None required.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. Provide products of Southwire, Houston Wire, Rome Cable, or similar manufacturer located within the continental United States market. Cables made in Europe, Asia, South America, Africa, or other overseas markets are not acceptable.

B. Substitutions: Equivalent manufacturers are allowed at contractors option, no submittals or prior approvals are necessary if cable meets specifications.

2.2 MATERIALS:

A. Application: For use in general wiring applications for lighting and power in ducts, conduits, wireways and other approved raceways with a maximum conductor temperature of 90 degrees C in dry locations and 75 degrees C in wet locations.

B. Provide wires and cables that are chemical, gasoline, and oil resistant. Provide wires and cables that are sunlight resistant.

C. Minimum conductor size shall be No. 12 AWG unless otherwise noted.

D. Where adverse conductor exposure exists, code approved insulation suitable for the conditions encountered shall be used unless shown otherwise on the Drawings.

E. Wire and cable shall be new, shall have grade of insulation, voltage and manufacturer's name permanently marked on outer covering at regular intervals and shall be delivered in complete coils or reels with identifying size and insulation tags.

2.3 COPPER CONDUCTORS:

A. For No. 10 AWG and smaller provide soft drawn solid copper conductors with type THHN/THWN insulation

2.4 ALUMINUM AND/OR METAL CLAD (MC) CABLING OPTIONS:

A. Aluminum and MC Cabling not acceptable – Provide copper only conductors.

2.5 COLOR CODE:

A. All wire shall be fully colored in sizes 12 and 10 AWG, and color banded at each end and at all junction and pull boxes for size 8 AWG and larger.

B. Color Code throughout the project shall be:

1. 480Y/277V System

Phase A	Brown
Phase B	Orange
Phase C	Yellow
Neutral	Grey
Neutral A (dedicated)	Grey w/brown stripe #12 & #10
Neutral B (dedicated)	Grey w/orange stripe #12 & #10
Neutral C (dedicated)	Grey w/yellow stripe #12 & #10
Equipment Ground	Green

2. 208Y/120V System

Phase A	Black
Phase B	Red
Phase C	Blue
Neutral	White
Neutral A (dedicated)	White w/black stripe #12 & #10
Neutral B (dedicated)	White w/red stripe #12 & #10

Neutral C (dedicated)	White w/blue stripe #12 & #10
Equipment Ground	Green
Isolated Ground	Green w/yellow stripe #12 & #10
	Green and Yellow bands #8 and up

3. 120/240V Single Phase System

Phase A	Black
Phase B	Red
Neutral	White
Neutral A (dedicated)	White w/black stripe #12 & #10
Neutral B (dedicated)	White w/red stripe #12 & #10
Equipment Ground	Green
Isolated Ground	Green w/yellow stripe #12 & #10
	Green and Yellow bands #8 and up

C. Provide a permanent, plastic engraved label on the inside of each branch-circuit panelboard throughout the project identifying the Color Code used throughout the project. Refer to NEC 200.6 (D).

2.6 SPLICES AND TERMINATIONS:

A. Splices shall utilize Scotch "Hyflex" or "Ideal" wing nut connector installed properly. Crimp on splices designed to be used without wire stripping are not acceptable.

B. Splices for No. 8 and larger wires shall be made with mechanically applied pressure type connectors.

C. All taped joints shall be with "Scotch 33+" or equal, applied in half-lap layers without stretching to deform.

D. Where splice box is subject to rain, weather, or moisture, provide “Rain Tight” termination device.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Inspect exposed cables for physical damage and remove as length allows.

E. Utilize pulling compound on long pulls.

C. Do not exceed manufacturers minimum bending radius or tension during installation.

D. Provide dedicated neutrals on all branch power receptacle circuits of 120/208 volt.

3.2 BRANCH CIRCUIT GROUNDED CONDUCTOR (NEUTRAL) WIRING METHODS:

A. Dedicated (separate) neutral wiring methods

1. Provide dedicated neutral wiring for the following systems:

   a. Lighting

   b. Receptacles

   c. Other than lighting and receptacle branch circuits

2. Provide dedicated (separate) neutral for each branch circuit; shared/common neutral wiring is not allowed.

3. For dedicated neutral branch wiring, there shall be no more than six (6) current carrying conductors allowed within a single raceway unless specifically allowed otherwise in the drawings. All neutral conductors shall be considered current carrying. Provide all required wire size increases to account for the applicable NEC wire ampacity deratings.

4. Provide dedicated neutral cables with colored stripe as required in wire color coding section for identification.

3.3 SPLICES AND TERMINATIONS:

A. Splices are to be made up complete promptly after wire installation.

B. Single wire pigtails shall be provided for fixture and device connections. Wirenuts may be used for fixture wire connections to single wire circuit conductor pigtails.

C. Install wing nut connector properly, according to manufacturers written instructions. Crimp on splices designed to be used without wire stripping are not acceptable.

D. Torque bolted connections to manufacturers recommendations.

E. Insulation shall be removed with a stripping tool designed specifically for that purpose. A pocket knife is not an acceptable tool. All conductors shall be left nick-free.

F. Thermoplastic insulated wire and cable shall not be installed or handled in temperatures below +14 degrees F (-10 C). Cross-linked polyethylene insulated wire and cable may be installed to -40 degrees F (-40 C).

3.4 LABELING:

A. Service Cables - Provide an engraved laminated 3-ply plastic “Lamicoid” or equal label which designated as “SERVICE CABLE(S)” attached with a nylon wire tie to the cables at each entry and exit from pullboxes, wireways and any other similar locations.

B. Feeders – Provide an engraved laminated 3-ply plastic “Lamicoid” or equal label with feeder name attached with a nylon wire tie to the feeder at each entry and exit from pullboxes, wireways and any other similar locations.

C. Branch Circuits – Clearly mark and identify the circuit number(s) at each junction box and similar location with a permanent black marker or equivalent that is clearly visible. For

concealed junction boxes the marking shall be made on the outside coverplate; for exposed boxes or boxes with finished coverplates marking shall be made on the interior of the box where visible when removing the coverplate.

3.5 COMMISSIONING AND TESTING:

A. Contractor shall provide for access and inspection of installed wires and cables by the Engineer, and owner. Notify Engineer of all tests at least 3 days prior to test. Owner and Engineer retain the right to witness some or all testing.

B. Document all tests and provide written copies in the O&M manuals.

C. Perform continuity tests and resistance measurements through bolted connections to ensure correct cable connections.

D. Perform insulation resistance test on all feeder conductors exceeding 100 amps, size #2 and larger. Values shall not be less than 50 megaohms.

END OF SECTION

SECTION 26 0533 - RACEWAYS

PART 1 - GENERAL

1.1 WORK INCLUDED:

A. Provide all raceways, wireways and associated fittings as herein specified and shown on the associated drawings.

1.2 APPLICATION:

A. Electric metallic tubing (EMT), galvanized rigid conduit (GRC), intermediate metal conduit (IMC), flexible metal conduit, and PVC conduit may be used.

B. Schedule 40 PVC conduit may only be used below grade and below slabs on grade. PVC may not be used above grade. Conduits larger than 1 inch shall be run below the slab.

C. GRC and IMC shall be used in locations subject to mechanical injury and for service conduit under buildings or concrete slabs.

D. EMT may be used only in dry and protected locations.

E. Flexible metal conduit will be permitted only where flexibility is necessary. Exceptions are connections to recessed light fixtures and work fished into existing concealed dry locations, and wood frame construction. Flexible metal conduit shall be used for connection to all equipment subject to movement or vibration such as motors and transformers.

F. Drawing notes requiring a specific type of raceway shall take precedence over the specifications.

G. Surface metal raceways equal to Wiremold (700 series unless noted otherwise) may be used only where specifically called for on the drawings or in the specifications. Such installation shall be directed by Architect.

H. Electrical wiring shall be in U.L. approved raceways and enclosures throughout.

I. 4" and larger conduits intended for use on primary services and communications services shall have minimum 48" radius sweep on all bends.

1.3 RELATED WORK SPECIFIED ELSEWHERE:

A. Basic Material & Methods – Section 26 0500.

B. Wires & Cables – Section 26 0519.

C. Ductbanks – Section 26 0539

1.4 QUALITY ASSURANCE:

A. All installation of conduits and raceways shall meet or exceed the following standards:

1. Polyvinyl Chloride (PVC): in accordance with ANSI C80.1 and NEMA Std. Pub. No. RN 1.

2. Rigid Metal Conduit (RMC): in accordance with ANSI C80.1.

3. Electric Metallic Tubing (EMT): in accordance with ANSI C80.3.

4. Seismic Bracing: ASCE 7-02, Section 9.6, latest edition

5. National Electric Code (NFPA 70) – Latest edition

6. UL listing is required

B. Manufacturer's shall be engaged in the manufacturing of industry accepted quality conduits and raceways for a period of no less than 5 years for all types and sizes required.

1.5 SUBMITTALS:

A. None required.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. Provide products of a quality manufacturer located within the continental United States market. Conduit and Raceways made in Europe, Asia, South America, Africa, or other overseas markets are not acceptable.

B. Substitutions: Equivalent manufacturers are allowed at contractor's option, no submittals or prior approvals are necessary if conduit and fittings meet specifications.

2.1 FITTINGS:

A. GRC and IMC shall be coupled and terminated with threaded fittings. Provide fully-threaded, malleable steel fittings, rain-tight and concrete-tight as applicable. Provide double locknuts and metal bushings at all conduit terminations. Ends shall be bushed with insulating bushings (OZ Gedney type B or equal).

B. Connectors and couplings for EMT shall be steel concrete tight set screw type with insulated throats on connectors. Die-cast fittings or fittings made from pot metal shall not be allowed. Indenter type fittings are not acceptable

C. Connectors larger than 1-1/4 inch shall include an insulating bushing.

D. Expansion Fittings: OZ Gedney Type AXDX, or equivalent to suit application.

E. Cable Supports: Provide OZ Gedney, or equivalent cable supports for vertical risers, type as required by application.

2.2 CONDUIT

A. Rigid Metal Conduit (RMC): Provide zinc-coated, hot-dipped galvanized, rigid metallic conduit in sizes indicated on the drawings. Provide RMC in ¾ inch minimum size.

B. Intermediate Metal Conduit (IMC): Provide hot-dipped galvanized, intermediate metal conduit in sizes indicated on the drawings. Provide IMC in ¾ inch minimum size.

C. Electric Metallic Tubing (EMT): Provide electric metal tubing in sizes indicated on the drawings. Provide EMT in ¾ inch minimum size.

D. Liquid-Tight Flexible Metal Conduit: Provide liquid-tight, flexible metal conduit, constructed of single strip, flexible continuous, interlocked, and double-wrapped steel, galvanized inside and outside, coated with liquid-tight jacket of flexible Polyvinyl Chloride (PVC). Provide Liquid-Tight Flexible conduit in ¾ inch minimum size.

E. Provide Schedule 40 PVC conduit (where installed below grade or below slab on grade) in one inch minimum size.

F. Aluminum Conduit is not acceptable.

G. MC and AC Cable is not acceptable.

2.3 BOXES

A. Refer to section 26 0500 for appropriate boxes.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Provide pull boxes where shown or required to limit the number of bends in any run to not more than three 90 degree bends. Use code gauge galvanized sheet steel boxes of code required size with removable covers, installed so that covers will be accessible after work is completed. Verify with the Architect any locations in finished areas.

B. Exposed raceways shall be parallel to structural lines.

C. Maintain a minimum of 12 inches spacing from Hot water and steam lines, and 6 inches from Chilled Water and Culinary Water lines. Do not support conduit from other utility services.

D. Do not install conduits in suspended slabs.

E. Support suspended feeder conduits by metal ring or trapeze hangers with threaded steel rods. If a large number of suspended feeders are grouped together, the contractor shall review the layout with the structural engineer and obtain approval for the proposed layout.

F. Conduit shall be adequately braced for Seismic Restraint, as required per ASCE 7-02, Section 9.6, latest edition.

G. Field bends and offsets shall be made without flattening, kinking, rippling or destroying the smooth internal bore or surface of the conduit and to not less than NEC minimum radius. Conduit that shows signs of rippling or kinking shall not be installed. Any conduits installed with wrinkles or kinks or otherwise in an unworkmanlike manner shall be replaced at no additional cost to owner.

H. Precaution shall be exercised to prevent accumulation of water, dirt, concrete, or other foreign matter in the conduits during the execution of the project. Conduits in which water or foreign matter has been permitted to accumulate shall be thoroughly cleaned or the conduits runs replaced where such accumulation cannot be removed by methods approved the engineer.

I. Permanently cap all spare conduits. Cap or plug conduit ends during construction to prevent entrance of foreign material.

J. For metal conduit systems, provide electrically continuous conduit systems throughout.

3.2 FIELD CUTS AND THREADS:

A. Cut all conduits perpendicular and square. Remove all sharp or rough edges and ream all burrs, inside and outside.

B. Provide clean sharp threads on RMC and IMC. Engage at least five full threads on all RMC and IMC fittings.

C. Before couplings or fittings are attached, apply one coat of red lead or zinc chromate to male threads of RMC or IMC.

D. Apply coat of red lead, zinc chromate or special compound recommended by manufacture to conduit where conduit protective coating is damaged.

3.3 EXPANSION AND SEISMIC JOINTS

A. Expansion Joints:

1. All conduits three inches and larger where not cast in concrete shall be rigidly secured to the building structure on opposite sides of a building expansion joint with an expansion-deflection fitting across the joint, equivalent to OZ/Gedney AXDX, installed per manufacturer's recommendations.

2. All conduits less than three inches where not cast in concrete shall be provided with junction boxes securely fastened on both sides of the expansion joint, connected together with 15 inches of slack (a minimum of 15 inches longer than the straight line length) flexible conduit and copper green ground bonding jumper.

In lieu of this flexible conduit, an expansion-deflection fitting, as indicated for conduits three inch and larger, may be installed.

B. Seismic Joints:

1. All conduits shall be provided with junction boxes securely fastened on both sides of the seismic joint, connected together with 15 inches of slack (a minimum of 15 inches longer than the straight line length) flexible conduit and copper green ground bonding jumper. Prior to installation, verify with Architect that the 15 inches is adequate for the designed movement, and if not, increase this length as required.

3.2 CONDUITS BURIED BELOW GRADE (SINGLE CONDUITS LESS THAN 3 INCHES)

A. Refer to Ductbanks section 26 0533 where concrete encasement is called out. All multi-conduit medium voltage campus power distribution and all multi-conduit campus telecommunications distribution must be concrete encased. Encasement is also required for building service entrance. Elsewhere on site, provide concrete encasement for single conduits where size is 3 inches and larger.

B. Where PVC conduit is below building slab on grade, conduit must be installed to be at least 2 inches below the slab. Provide 2 inches of sand or pea sized gravel to cover conduit. Protect conduit from vehicle traffic and construction traffic prior to concrete pour. Conduit poured inside the slab for slab on grade construction is not acceptable.

B. Elbows larger than 30 degrees and one inch shall be galvanized rigid conduit, wrapped with PVC tape, or fiberglass sweep elbows, at contractors option.

C. Provide a ground wire sized per code in all PVC conduits intended for power circuits when pulling wire. Conductor quantities indicated on plans do not include ground wires unless otherwise noted.

D. Provide trenching, backfilling, compaction, re-paving or other site restoration as required by the work done in this division.

E. Minimum ductbank burial is 36 inches unless otherwise noted. For single conduits less than 3 inches, minimum trench depth shall be 24" unless otherwise noted.

F. Install a detectable 6 inch wide yellow vinyl tape with letter "Caution: Buried Electrical Line Below" 18 inches above all buried service conduit and wire not under structures.

G. Backfill material for all trenches under paved areas shall be coarse sand or crushed rock, installed in layers not to exceed eight inches and compacted to 95% of maximum density at optimum moisture content to preclude subsequent settlement. Compaction by water method is not allowed. The top 18 inches of trenches in landscaped or grassed areas shall be backfilled with native soil and tamped.

H. Conduits piercing a building waterproof membrane shall be provided with flanges, using two neoprene washers, one washer on each side of membrane, between each flange and membrane.

I. All underground conduits which enter the building shall be sloped to drain away from the building and shall be water sealed to prevent moisture from passing through the conduit into the building. All joints to be threaded and taped or glued to prevent entry of water into the conduits.

J. All underground conduits entering the building shall be poured-in-place, or provided with watertight conduit sleeves and rubber seals, Link-seal system by Thunderline Corporation or equivalent.

3.4 CLEANING:

A. Pull a mandril and swab through all conduit before installing conductors. Raceways shall be left clean and free of debris.

B. Provide a pull string in all empty conduits.

3.5 COMMISSIONING AND FINAL INSPECTION:

A. Contractor shall provide a time for access and inspection of raceway system for the Engineer, telecommunications installer and the owner. Correct all defects and flaws found prior to cabling installation.

B. Demonstrate electrical continuity at selected joints to the Engineer and Owner using an electrical ohmmeter.

C. Demonstrate rigid seismic bracing to ensure minimal movement of the raceways on suspended racks in a seismic event. Demonstration shall be by pushing with at least 25 pounds force laterally and longitudinally at selected (mid-span) locations along the length of the suspended raceway rack. Rack shall not move more than 2 inches during these demonstrations.

END OF SECTION

SECTION 26 05 36 – CONCRETE MANHOLES

PART 1 - GENERAL

1.1 WORK INCLUDED:

A. Furnish and install all concrete manholes, ladders, and accessories as herein specified and shown on the drawings.

1.2 RELATED WORK SPECIFIED ELSEWHERE:

A. Basic Material & Methods – Section 26 0500.

B. Raceways – Section 26 0533

C. Ductbank – Section 26 0539

1.3 QUALITY ASSURANCE:

A. Materials and installation shall meet or exceed the following standards:

1. Reinforcing Steel: Conform to ASTM 0615.

2. Concrete: ASTM C94

3. National Electric Code (NFPA 70) – Latest edition

B. Manhole and accessory manufacturer's shall be engaged in the manufacturing of industry accepted quality precast manholes and quality accessories for a period of no less than 5 years for all types and sizes required.

1.4 SUBMITTALS:

A. Submit complete descriptive shop drawings indicating overall and interior dimensions, reinforcing steel, keyways, and concrete aggregate of new precast manholes and risers. Prepare and submit these shop drawings as indicated in the General Conditions, Division 01, and section 26 0500.

B. Submit product data of all accessories including ladders, Sidewalk Doors, lids, pulling irons, grates, imbedded struts, and other accessories. Submit in accordance with the general conditions, division 01, and section 26 0500.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. Amcor Precast, Duracrete Inc., Eagle Precast, or poured in place

B. Requests for substitution of other products will be considered if submitted in accordance with the General Conditions, Division 01, and Section 26 05 00.

2.2 MATERIALS:

A. Concrete manhole vaults shall be constructed of precast or poured in place concrete. Precast materials shall be shipped to the jobsite as a unit assembly unless separate vertical sections are assembled at the jobsite by stacking. Stacked sections shall be sealed with suitable material. Keyway all stacked sections to prevent shifting and movement after installation.

B. Provide manhole interior dimension height as detailed on the drawings.

C. Easily removed knockouts shall be provided to permit conduit entrance. Locate knockouts only where conduits will be installed in this contract. Do not install future knockouts. Knockouts shall be located within a few inches of the corner of the manhole, to allow ease of racking of all cabling exiting the ductbanks.

D. Vault floor shall be pitched for drainage and one or more drain holes shall be provided.

E. Superstrut C300 series mounting channel, or equal of Unistrut, shall be cast into interior walls.

F. Pulling-in irons shall be included inside each manhole as detailed.

G. Cable supports shall be provided for all cables, as detailed, fastened to wall channels. Racks shall be of galvanized steel and shall be of the removable type. The metal portion of racks shall be zinc-coated after fabrication.

H. Manhole ladder of sufficient length for total depth of the manhole plus grade rings shall be provided. Ladders that prove too short shall be replaced. Provide stainless steel ladders, of heavy duty construction, Suitable for a man and equipment weighting 300 pounds, with 12 inch rung spacing. Rungs shall be treated for slip resistant surface. Ladder shall not bend excessively with 300 pounds in center. Ladders shall have mechanical connection to manhole rings at entry, to prevent ladder from sliding or falling.

I. Embedded metal parts such as channels, pulling-in inserts and cable supports, and bell ends on conduit shall have grounding connection.

J. Frame and cover for manholes shall be standard manhle entries, troffer pattern, non-ventilated, cast iron with 30" clear opening size; cast-in inscriptions "ELECTRIC". Riser sections shall be provided to support manhole frame and cover at grade. Inside diameter of riser sections shall be 42".

K. Provide two ground rods for each manhole; copperweld 3/4" diameter, 10'-0" long driven just inside the finished wall with top 4" above the finished floor. Ground all metal items within the manhole with No. 6 bare stranded soft drawn copper wire.

L. All cables and splices shall be racked to side walls. Supports for cables shall be cable clamps of dry-process glazed porcelain. The clamps shall consist of porcelain half circles mounted on rolled steel sections with a steel clamp and locking screw. The supports shall be Burndy, Unistrut, Superstrut, or Elcen. All channels, attachments and parts shall be hot dip galvanized.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Seal surfaces between sections on multi-section vaults must be clean and all gaskets must be in place. Excavation hole must not contain water when setting vault. Excavation must provide a minimum of 18 inches clearance around the side walls of each vault for ease of installation and for compaction of backfill.

B. Backfill around all vaults with engineered fill, pea gravel or sand. No voids should remain between the vault walls and native soil. Backfill must be progressively compacted from the bottom to the top surface. Provide 12 inches of compacted gravel, graded level, under each vault for drainage.

C. Seal all joints between vault sections, lid, risers, covers, etc. with appropriate gasket or sealant. Apply in a manner to insure filling of all voids in the joint being sealed.

D. Where digging into existing manholes, reset the grade rings and reseal all voids with new sealant. Replace any broken grade rings and replace rings made of masonry.

E. All cables and splices shall be separated by feeder and shall be fire taped with 3M fire tape per manufacturers instructions.

F. Install bell ends on all new conduits entering both new and existing manholes or vaults. Bell ends shall be installed flush with wall, which requires drilling an oversize hole. Seal around the bell end with solid grout.

3.2 LABELING:

A. Contractor shall provide permanent labeling as indicated in this section for <u>every</u> manhole and vault entered for demolition and new work.

B. All feeders shall be tagged with metal identification tags indicating the wire size, conductor type, and feeder designation. Example: “350EPR AL - F1”. Provide (1) tag between three and six feet from the ductbank location for every new and existing feeder within the manhole. Feeders shall be labeled as indicated on the new manhole detail drawings.

C. Spray paint black, with lettering template, label the manhole name inside the manhole at the lid location.

D. Provide permanent engraved nameplates for every individual ductbank location indicating the next location for the ductbank (for example: TO MH.3). Nameplate shall be 1/16 inch thick, laminated three-ply plastic, center-ply white, outer-ply red or black "Lamicoid" or equal. Letters shall be formed by engraving outer black or yellow ply, exposing white center-ply. Letters shall be a minimum of 6” in height. Nameplates are to be securely attached either next to, above or below the applicable ductbank in a location that is clearly visible from inside the manhole. Label based on the new manhole detail drawings.

E. Provide sample labeling and scheme for each item to be labeled to Engineer prior to beginning labeling within the manholes/vaults.

3.3 CLEANING:

A. Do not allow storm runoff, mud, and water to enter manholes during construction activities. Water is particularly hazardous to unterminated conductors, it will “wick” up the cable several feet and cause early failure.

B. Manholes shall be left clean and free of debris.

3.4 COMMISSIONING AND FINAL INSPECTION:

A. Contractor shall provide a time for access and inspection of manholes for the Engineer, Inspector,and/or the owner. Correct all defects and flaws found prior to cable installation.

END OF SECTION

SECTION 26 05 39 - DUCTBANKS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

A. Provide all underground non-metallic duct lines for certain underground raceways, for extent shown. Concrete encase as detailed on the drawings.

B. All multi-conduit medium voltage campus power distribution and all multi-conduit campus telecommunications distribution must be concrete encased. Encasement is also required for building service entrance. Elsewhere on site, provide concrete encasement for single conduits where size is 3 inches and larger.

1.2 RELATED WORK SPECIFIED ELSEWHERE:

A. Basic Material & Methods – Section 26 0500.

B. Wires & Cables – Section 26 0519.

C. Raceways – Section 26 0533

1.4 QUALITY ASSURANCE:

A. All installation of conduits and raceways shall meet or exceed the following standards:

1. Polyvinyl Chloride (PVC): in accordance with ANSI C80.1 and NEMA Std. Pub. No. RN 1.

2. Rigid Metal Conduit (RMC): in accordance with ANSI C80.1.

3. Reinforcing Steel: Conform to ASTM 0615.

4. Concrete: 2500 psi concrete to ASTM C94

5. National Electric Code (NFPA 70) – Latest edition

6. UL listing is required

B. Manufacturer's shall be engaged in the manufacturing of industry accepted quality conduits and raceways for a period of no less than 5 years for all types and sizes required.

1.5 SUBMITTALS:

A. None required.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. Provide products of a quality manufacturer located within the continental North American market. Conduit and Raceways made in Europe, Asia, South America, Africa, or other overseas markets are not acceptable.

B. Substitutions: Equivalent manufacturers are allowed at contractor's option, no submittals or prior approvals are necessary if conduit and fittings meet specifications.

2.2 DUCT LINES AND ACCESSORIES:

B. Ducts: Rigid polyvinyl chloride conduit; Schedule 40, Type I, conforming to UL Article 651. Beneath building, ducts shall be rigid galvanized steel.

C. Couplings: Slip-on, solvent sealed to pipe; solvent, Western No. 715.

D. Adapters to Underground Conduit: Conduit ends shall be closely fitted without any rough edges of offsets. Maintain existing line and grade.

E. Spacers and Bindings on Multiple Conduit Runs: Plastic, same manufacturer as raceways; embedded in the concrete; 1-1/2" clearance between raceways.

2.3 CONCRETE AND REINFORCING STEEL

A. Reinforcing Steel: #4 and #3 reinforcing bar as shown on the drawings and as described herein.

B. Concrete: 2500 psi concrete, maximum aggregate size, 1"; purchased from a local source approved by the Owner's representative.

C. Red Dye: For Medium voltage ductbanks, provide red dye to sprinkle over the top of the ductbank.

PART 3 - EXECUTION

3.1 UNDERGROUND DUCT LINES:

A. Depth of Conduit: Ductbank Installed Underground: 3'-0" minimum below finished grade to top of conduit.

B. Location of ductbanks shown on the drawings is approximate. Contractor shall verify existing utilities, review site features such as trees, shrubs, and plantings, coordinate with other new utilities, and determine any conflicts. If conflicts exist, contractor shall shift ductbank up to 10 feet either direction with approval from the owner at no extra cost to the contract. Where installed location varies from plans, contractor shall increase the wire length installed under this contract as appropriate.

C. Minimum vertical spacing to other utilities shall be 12 inches vertically, packed with sand. Rise and fall the electrical ductbank gradually, or spread out the ductbank flat, to provide this clearance. Where situations prevent full clearance, discuss reducing the clearance with the owner. In no case shall clearance be less than 6 inches.

D. Minimum horizontal spacing to other utilities: Minimum horizontal spacing to other new utilities is 3 feet horizontal. Where situations and existing conditions prevent the full separation, consult with owner and Engineer to see if reductions are possible.

E. Shared Trench with power, and cable TV/telecomm conduits: Minimum horizontal spacing to telecomm ductbanks is 6 inches. Contractor may share the trench and form two separate ductbanks, or pour all conduits as one ductbank as per the contractor's option. However, a full 6 inches of separation will be required for the entire distance between the power conduits and telecommunications conduits. Telecomm/Cable TV conduits may not enter power manholes.

F. Grade: Install with uniform gradient between end pulling points; 3" in 100', minimum.

G. Couplings: Provide for slip-on, solvent sealed to pipe.

H. Spacing of spacers and binding of multiple duct lines; 8'-0" on centers.

I. Provide rigid galvanized steel conduit at ends and bends, through slab at pad-mount transformer, and for all duct banks installed beneath the building. Connections to underground steel conduit shall be closely fitted without any rough edges of offsets. Maintain line and grade.

J. Reinforcing Steel: Provide bars in duct banks including two No. 4 bars as shown, full length; and transverse ties on 18" centers, formed from No. 3 bars. Ends of bars shall be lapped 40 diameters and tied with No. 20 gage soft annealed steel wire. Bars shall extend full length of underground raceways.

K. Concrete Encasement: For all duct-lines and connection conduit, encasement thickness 3" minimum.

L. Provide trenching, backfilling, compaction, re-paving or other site restoration as required by the work done in this division.

M. Backfill material for all trenches under paved areas shall be coarse sand or crushed rock, installed in layers not to exceed eight inches and compacted to 95% of maximum density at optimum moisture content to preclude subsequent settlement. Compaction by water method is not allowed. The top 18 inches of trenches in landscaped or grassed areas shall be backfilled with native soil and tamped.

K. Elbows encased in concrete larger than 30 degrees shall be galvanized rigid conduit, wrapped with PVC tape, or fiberglass sweep elbows, at contractors option.

3.2 FIELD CUTS AND THREADS:

A. Cut all conduits perpendicular and square. Remove all sharp or rough edges and ream all burrs, inside and outside.

B. Provide clean sharp threads on RMC and IMC. Engage at least five full threads on all RMC and IMC fittings.

C. Before couplings or fittings are attached, apply one coat of red lead or zinc chromate to male threads of RMC or IMC.

D. Apply coat of red lead, zinc chromate or special compound recommended by manufacture to conduit where conduit protective coating is damaged.

3.3 PEDESTRIAN AND TRAFFIC CONTROL

A. The contractor shall provide proper access to all buildings at all times. Do not block pedestrian access to buildings, unless a suitable 2nd entry is available that is fully ADA compliant.

B. Where temporary pathways or bridges are needed to provide access, provide suitable hard surface, such as asphalt, sheet steel, or plywood, for wheelchair access. There shall be no tripping hazards for temporary bridges or temporary pathways.

C. Excavating contractor and electrician shall provide proper barricades to prevent pedestrians and vehicles from entering the construction site. “ticker” tape is not a sufficient barricade. Use proper jersey barriers for traffic control, and full 5 foot minimum height fencing to prevent pedestrian access during day and nighttime hours to open trenches and manhole excavations.

D. Contractor shall provide signage including detour signage directing pedestrians and vehicles around construction sites. Signage shall be in place prior to start of excavation activities.

3.4 SITE DUST, MUD, STORM DRAIN, AND EROSION CONTROL

A. Contractor shall take measures to avoid tracking mud and dirt into streets and areas outside of the construction zone. Where appropriate, clean streets, gutters, and other areas in hauling zones daily.

B. Refer to Civil plans and specifications for storm drain and erosion control.

3.5 CLEANING:

A. Pull a mandril and swab through all conduit before installing conductors. Raceways shall be left clean and free of debris.

B. Pull Wires: Install 1/32 minimum polypropylene rope, Jet-Line "Poly Rope" or Ideal "Pro-Pull" rope in all ducts and conduits, except where wiring is installed under this contract; approximately 3'-0" of free rope left at each switch cabinet, manhole and/or transformer.

C. Provide paving and site restoration and cleanup as required to restore the area to original condition. Coordinate work with other trades as applicable.

3.6 COMMISSIONING AND FINAL INSPECTION:

A. Contractor shall provide a time for access and inspection of raceway system for the Engineer, Inspector, owner, telecommunications installer and/or Cable TV installer. Correct all defects and flaws found prior to concrete installation.

END OF SECTION

SECTION 26 08 00 – COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 WORK INCLUDED:

A. Provide all materials, equipment, documentation, submittals, testing, and training as specified herein as well as within all Divisions 26, 27 and 28 as well as Divisions 22, 23 and 25 as indicated.

B. See the contract conditions (general and supplementary) and Division 1 for requirements concerning this Division including, but not limited to, commissioning, submittals, shop drawings, maintenance manuals, and guarantees.

1.2 SCOPE OF COMMISSIONING:

A. Commissioning shall be provided for all electrical systems as stated below. For the specific commissioning requirements of each system refer to the indicated section.

1. Switchboards above 600V (26 13 00)

2. Panelboards (26 24 16)

3. Wires and Cables over 600 volts (26 05 13)

4. Schedule work so that required electrical installations are completed, and systems verification checks and functional performance tests can be carried out on schedule. Inspect, check and confirm in writing the proper installation and performance of all electrical services provided.

5. Provide electrical system technicians to assist during system verification and functional performance testing as required by the CA.

1.3 RESPONSIBILITIES:

A. Refer to Section 1 for responsibilities of the: Owner, Contractor, and CxA.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT:

A. Provide all materials and equipment required for the commissioning of all items to be commissioned.

B. Material and equipment shall be standard product of manufacturer regularly engaged in production of similar material for at least five years (unless specifically exempted) and shall be manufacturer's latest design.

PART 3 - EXECUTION

3.1 COMMISSIONING:

A. Division 26 is responsible to ensure required systems are commissioned according to their particular guidelines as stated in each individual section.

B. Training shall be provided as required in the specific section specifications.

3.2 COMPLETION:

A. Contractor shall submit written certification that all commissioning has been completed as indicated within the specifications.

END OF SECTION

SECTION 26 09 13 – ELECTRIC POWER MONITORING

PART 1 - GENERAL

1.1 WORK INCLUDED:

A. Provide a power metering/monitoring system including CT's, PT's, meters, communication equipment, capable of a graphical presentation on switchboard section, and also capable of tie to a SCADA system for collection of metering data.

1.2 QUALITY ASSURANCES:

A. Provide all components and accessories with UL listing.

1.3 SUBMITTALS:

A. Submit complete and descriptive product data indicating dimensions and compliance with specifications herein.

B. Submit shop drawings, including network wiring diagrams, showing interconnecting wiring between individual monitors and the computer based software. Include all wiring required.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with all requirements, provide metering equipment from one of the following:

1. Square D

2. Siemens

3. General Electric

B. Requests for substitution of other products will be considered if submitted in accordance with the General Conditions, Division 1, and Section 26 05 00.

2.2 METERS LOCATED AT MAIN SWITCHBOARDS (SERVICE ENTRANCE):

A. Provide digital metering Square D Power Logic Circuit Monitor, Class 3000, Model CM-3350 with VFD Display, or equivalent, integrally mounted in service switchboard, completely wired with current transformers, potential transformers, control power transformer, and fusing.

B. Provide meter with RS485 capability.

C. Provide meter with the following features:

1. Front panel features:

   A. LCD electronic display
   B. Kilo/Mega units LEDs
   C. Meter indication LEDs
   D. Setup/rest parameters
   E. Phase indication LEDs
   F. Phase select button
   G. Select meter buttons
   H. Mode indication LEDs
   I. Mode select button
   J. communications port

2. True RMS Metering
3. Accepts standard CT and PT inputs
4. 0.2% accuracy, current and voltage
5. Min/Max displays for metered data
6. On-board clock/calendar
7. RS-485 Communications standard
8. Setpoint controlled alarm/relay functions
9. On-board event and data logging
10. Waveform capture
11. High-speed, triggered 12-cycle event capture
12. Date/time for each Min/Max
13. Optional voltage/power module, where required, for direct connection to 480Y/277 V systems.
14. Non-volatile memory to retain demand readings during power bumps

D. Provide meter with instrumentation to displaying the following information:

1. Real-time readings:

   A. Current (per phase, N, G, 3 phase)
   B. Voltage (L-L, L-N).
   C. Real power (per phase, 3 phase)
   D. Reactive Power (per phase, 3 phase)
   E. Apparent power (per phase, 3 phase)
   F. power factor (per phase, 3 phase)
   G. Frequency
   H. THD (current and voltage)
   I. K-factor (per phase)

2. Demand Readings:

   A. Demand current (per-phase present, peak)
   B. Average power factor (3 phase total)
   C. Demand real power (3 phase total)

D. Demand apparent power (3 phase total)

3. Energy Readings:

A. Accumulated energy, real
B. Accumulated energy, reactive

4. Power Analysis Values:

A. Crest factor (per phase)
B. K-factor demand (per phase)
C. Displacement power factor (per phase, 3 phase)
D. Fundamental voltages (per phase)
E. Fundamental currents (per phase)
F. Fundamental real power (per phase)
G. Harmonic power
H. Unbalance (current and voltage)
I. Phase rotation

2.3 METERS LOCATED AT SUBBREAKERS OR BRANCH PANELS:

A. Provide digital metering Square D Power Logic Circuit Monitor, Class 800, Model PM-820, or equivalent, integrally mounted in switchboard or panelboard, or separately mounted in separate enclosure, completely wired with current transformers, potential transformers, control power transformer, and fusing.

B. Provide meter with the following features:

1. Front panel features:

A. electronic display
B. Kilo/Mega units LEDs
C. Meter indication LEDs
D. Setup/rest parameters
E. Phase indication LEDs
F. Phase select button
G. Select meter buttons
H. Mode indication LEDs
I. Mode select button
J. communications port

2. True RMS Metering
3. Accepts standard CT and PT inputs
4. 0.2% accuracy, current and voltage
5. Min/Max displays for metered data
6. On-board clock/calendar
7. RS-485 Communications standard
8. Setpoint controlled alarm/relay functions
9. On-board event and data logging
10. Date/time for each Min/Max

11. Optional voltage/power module, where required, for direct connection to 480Y/277 V systems.

C. Provide meter with instrumentation to displaying the following information:

1. Real-time readings:

   A. Current (per phase, N, G, 3 phase)
   B. Voltage (L-L, L-N).
   C. Real power (per phase, 3 phase)
   D. Reactive Power (per phase, 3 phase)
   E. Apparent power (per phase, 3 phase)
   F. power factor (per phase, 3 phase)
   G. Frequency
   H. THD (current and voltage)
   I. K-factor (per phase)

2. Demand Readings:

   A. Demand current (per-phase present, peak)
   B. Average power factor (3 phase total)
   C. Demand real power (3 phase total)
   D. Demand apparent power (3 phase total)

3. Energy Readings:

   A. Accumulated energy, real
   B. Accumulated energy, reactive

PART 3 - EXECUTION

3.1 INSTALLATION:

A. All cable routing shall be done in a neat and workmanlike manner consistent with recognized good practice and in accordance with the manufacturer's instructions.

B. The Contractor is responsible to have checked all plans and specifications for possible interference with other trades before installing System components, and to coordinate as required to provide an acceptable installation.

3.2 MANUFACTURER'S ASSISTANCE:

A. The System manufacturer shall provide the services of a trained "factory representative" to assist and instruct the electrical contractor in the proper installation of the components and system.

3.3 COMMISSIONING

A. Demonstrate metered data at each individual monitor, and at the central SCADA system, indicating a properly working system. Include test data for current, voltage, and power measurements.

B. Provide owner training, by a trained factory expert, consisting of two independent sessions, minimum of 2 hours session, demonstrating system programming and monitoring functions. Include all training time and travel expenses in original bid. The Owner training session may be videotaped by the commission agent for future owner use.

C. All testing and training shall be performed in the presence of the commissioning agent and/or Engineer.

END OF SECTION

SECTION 26 12 19 – PAD MOUND TRANSFORMERS

PART 1 - GENERAL

1.1 WORK INCLUDED:

A. Provide all transformers as herein specified and shown on the drawings.

1.2 RELATED WORK SPECIFIED ELSEWHERE:

A. Basic Material & Methods – Section 26 0500.

B. Wires and Cables over 600 volts– Section 26 0513.

1.3 QUALITY ASSURANCE:

A. All transformers shall meet or exceed the following standards:

1. All transformers must be constructed and rated in accordance with all applicable ANSI, and NEMA Standards.

2. U.L. listed.

3. National Electric Code (NFPA 70) – Latest edition

4. Commissioning and Testing procedures: NETA 7.2.2 and Table 100.12.

B. Manufacturer's shall be engaged in the manufacturing of industry accepted quality liquid filled tranformers for a period of no less than 5 years for all types and sizes required.

C. Each transformer shall be newly manufactured (no more than 12 months old) and shall bear a tag containing the name of manufacturer, and year of manufacture.

1.4 SUBMITTALS:

A. Submit complete and descriptive shop drawings indicating compliance with the specifications herein. Submit in accordance with the General Conditions, Division 01, and Section 26 0500.

B. Submit dimensioned drawings of transformer showing size, weight, center of gravity, and in both plan view and elevation view. Include all accessories including gauges, valves, bushing wells, and lightning arrestors.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. Cutler Hammer/Westinghouse, General Electric, Brown Boveri, MGM, Baltau Standard, Square D, Cooper.

B. Requests for substitution of other products will be considered if submitted in accordance with the General Conditions, Division 01, and Section 26 05 00.

2.2 EQUIPMENT:

A. Transformers shall be isolating type unless otherwise specified. KVA and voltage rating shall be as specified on the drawings. All transformers must be constructed and rated in accordance with all applicable ANSI, NEMA, and U.L. Standards.

C. Furnish and install a pad mounted, liquid filled, FR3 fluid insulated (vegetable oil based), 3 phase, 60 cycle transformer for outdoor installation. Oil Filled, Silicon filled, and R-Temp filled transformers are not acceptable.

D. Windings shall be copper.

E. Three phase transformers shall have a delta primary. Provide wye and/or delta secondary as indicated on the drawings. The single phase transformers are not required to be a delta primary configuration. The single phase transformers are to be a two tap loop feed primary with the second tap to use a lightning arrester.

F. Furnish four 2-1/2% full capacity taps in the primary winding, two above and two below rated primary voltage, brought out to an externally operated de-energized tap changer.

G. The transformer and associated terminal compartments shall be so designed and constructed as to be tamperproof. There shall be no screws, bolts, or other externally removable fastening devices. Full height, air-filled incoming and outgoing terminal compartments with hinged doors shall be located side by side separated by a steel barrier. The incoming compartment will be accessible only after the door to the outgoing compartment has been opened. The incoming line compartment shall enclose the high voltage bushings and provide for incoming cable from below. The compartment shall have a hinged door with a fastening device which is accessible only through the low voltage compartment. The incoming line compartment shall be arranged for two cable circuits to the transformer.

H. The incoming line compartment shall have bushings arranged for two cable circuits to the transformer (loop feed). Only one cable feeder will be installed, the second set of bushings will be used for lightning arrestors. Furnish and install lightning arrestors with the transformer.

I. Six 200 amp bushing wells to accept load break elbows and/or lightning arrestors shall be furnished which will accept elbows and hold down hardware.

J. The outgoing line compartment shall be arranged for cabling from below. The compartment door will be hinged and suitable for padlocking. Provide four low voltage spade bushings or three low voltage spade bushings and one solidly grounded neutral blade for grounded Y secondary voltage.

K. The transformer shall be painted olive green color, Munsel #7GY3.29/1.5.

L. Provide transformer accessories including drain valve with sampling device, filling plug and filter, liquid level guage, dial thermometer, oil temperature guage, and anchor lugs and lifting eyes.

M. Transformer impedance shall be supplied in the range of 4-1/2% to 5-1/2%.

N. Provide cooling fins as recommended by the manufacturer.

2.3 LIGHTNING ARRESTORS:

A. Provide lightning arrestors that match and mate with 200 amp bushing wells.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install transformers on raised concrete housekeeping pads. Anchor transformers to pad to avoid seismic movement with bolts sized per manufacturers recommendations.

B. Transformer dimensions vary widely from manufacturer to manufacturer. Verify equipment size, low voltage compartment size and location, and high voltage compartment size and location prior to roughing in conduits and prior to pouring equipment pads. Verify proper clearances around transformers. If required, provide larger pad at no extra cost to the owner.

3.2 ADJUSTMENTS:

A. Transformer taps are to be adjusted to the proper voltage after system is installed and operating under load.

3.3 COMMISSIONING AND TESTING:

A. Factory testing: Transformers shall be completely fabricated and tested at the factory prior to shipment.

B. Field testing: Notify the owner and engineer at least 3 days prior to field testing and startup. The owner and engineer reserve the right to witness all or some transformer testing.

C. Follow recommendations of the National Electrical Testing Association (NETA), latest version.

D. All secondary transformer lugs shall be thermal imaged under load. Provide report in O&M manuals. Where necessary, retorque terminations.

END OF SECTION

SECTION 26 13 00 – MEDIUM VOLTAGE SWITCHGEAR OVER 600 VOLTS

PART 1 - GENERAL

1.1 WORK INCLUDED:

A. Furnish and install the 15KV Metal Clad Switchgear as herein specified and shown on the associated electrical drawings.

1.2 RELATED SPECIFICATION SECTIONS

A. 26 05 00 BASIC ELECTRICAL MATERIALS AND METHODS

B. 26 05 34 DUCT BANK

C. 26 08 00 COMMISSIONING OF ELECTRICAL SYSTEMS

1.3 REFERENCES

All equipment is to be designed and manufactured per the latest standards available unless otherwise noted below:

A. ANSI C37.06, Switchgear – AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis – Preferred Ratings and Related Capabilities

1. ANSI C37.06a supplement

B. IEEE C37.04, Rating Structure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Basis

1. IEEE C37.04C, C37.04G, C37.04H, C37.04I supplements

C. ANSI/IEEE C37.20.2, Metal-Clad and Station-type Cubicle Switchgear

D. ANSI/IEEE C57.13, Instrument Transformers, Requirements for.

E. IEEE C37.90, Standard for Relays and Relay Systems Associated with Electric Power Apparatus.

F. NEMA SG 4, Alternating – Current High Voltage Circuit Breaker

G. NEMA SG 5, Power Switchgear Assemblies

1.4 SYSTEM DESCRIPTION

A. New switchgear is for use on a 12.5 KV, 3-phase, 4-wire low resistance grounded 60-Hz system. Switchgear shall be rated as indicated on the associated drawings. All applicable elements of construction shall have a basic impulse rating (BIL) of 95 KV. Equipment shall be completely factory-built, assembled, wired and tested. All equipment

and components shall be new construction. Circuit breakers, meters, and relays shall all be factory tested.

B. The new gear shall be integrated into an existing electrical building with utility service relocated to feed the new gear, and one breaker backfeeding the second gear lineup. Careful interface with the existing controls system for backup generator and wind interface is required.

1.5 SUBMITTALS:

A. Submit complete descriptive documents to owner for review and evaluation in accordance with the general requirements of division 26:

1. Product data sheets including complete electrical ratings of equipment.
2. Shop drawings
   a. Dimensioned floor plan for the switchgear
   b. Dimensions for external conduit and wiring entrances
   c. Dimensioned exterior section views of the switchgear
   d. Dimensioned switchgear front elevations including mimic bus.
   e. Internal bussing arrangement section views
   f. Seismic certifications from manufacturer as described in section 26 0548.
   g. Anchoring requirements prepared by a Utah licensed structural engineer including soil reports, and site specific requirements including existing grade and other site constraints. Includes recommended anchor bolts and anchor locations.
   h. Complete internal wiring diagrams, single line schematic wiring diagrams, 3-line schematic wiring diagrams, interconnection wiring diagrams
   i. Provide interface wiring diagram modifications for the <u>required interface with the existing controls and monitoring system</u>. Coordination with the generator and wind project is mandatory, and field verification of said wiring is required by contractor and selected manufacturer prior to production of new gear.
3. Certified copies of all Test Reports
4. Note: The existing battery and charger system may be expanded. The Battery duty cycle calculations based on loss of charger DC power for a 24 hour standby period that includes operation of all DC load (control power supplies, relay power supplies, communication processors, pilot lights, etc.) At the end of the 24 hour standby period the calculations shall include operation of each lock out relay to trip each breaker. Another 8 hour standby period after breaker trip shall be observed followed by closing of breakers.
5. Installation diagrams for all field wiring and shipping split wiring requirements.
6. CT saturation calculations

7. Technical data, part numbers, and installation instructions for all individual components including but not limited to protective relays, breaker components, pilot lights, battery charging systems, AC panel, DC panel, and lighting.

8. Nameplate data including interrupting ratings for breakers, bussing and internal bracing.

9. Available accessories for the specific build.

10. Welding certifications and testing reports for building switchgear housing.

1.6 PROJECT RECORD DOCUMENTS

A. Contractor shall maintain an up-to-date set of contract documents (including field changes to the submittal drawings). Note any and all revisions and deviations made during the course of the project. All changes shall be tracked and discussed during project meetings with the owner and engineer.

1.7 OPERATION AND MAINTENANCE MANUALS

A. Manufacturer shall provide copies of installation, operation, and maintenance manuals to owner in accordance with the general requirements of Division 1 and Division 26.

B. Provide operation and maintenance manuals shall include the MTBF information of all critical switchgear components for use in maintaining critical spare parts.

C. Provide copies of all certified test reports.

D. Provide final factory drawings in an electronic format in addition to hardcopy submittals in a CAD compatible format.

1.8 MANUFACTURER QUALIFICATIONS

A. Certificate of ISO 9001 Compliance

B. Manufacturer shall be specialized in the manufacture and assembly of metal clad switchgear for a minimum of 10 years

C. Switchgear shall be qualified for use in the following seismic areas:

1. Manufacturers of all submitted equipment shall provide data indicating that their equipment has met a shake table test as per IEEE method or has been calculated to withstand the forces expected at the site of installation. It is required for the manufacturers to submit a certificate or letter indicating the Importance Factor and S_{DS} factor that the equipment is tested to withstand.

1.9 WARRANTY

A. In addition to the basic warranty requirements in Section 260500 provide:

1. 5 year parts and labor warranty for main breakers, from date of substantial completion acceptance.

2. 10 year warranty on all protective relays and associated communications processors, from date of substantial completion acceptance.

1.10 SEQUENCE OF OPERATIONS

A. General

1. The sequence of operation is preliminary and will be modified as the project progresses. The manufacturer shall provide insight into any recommendations made by the design and installation team to finalize the sequence of operation

2. All transfers, closing, and opening operations are to be completed by local means in a manual fashion

1.11 ALTERNATEE PARTS AND MATERIALS

A. Provide for the following extra materials, installed, wired, and tested for a future solar power feeder interface:

1. Spare breakers as shown on the one line diagrams

2. Spare relays as shown on the one line diagrams

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. SWITCHGEAR: GE, Square D, Siemens.

B. BREAKERS: GE, Square D, Siemens.

C. RELAY EQUIPMENT: GE, or Schweitzer SEL.

D. ABB gear and breakers are not acceptable as they have not proved their seismic withstand for the installed location.

2.2 EQUIPMENT:

A. Enclosures

1. Switchgear Enclosure

a. Switchgear shall consist of breaker and auxiliary units, as indicated on drawings to form a rigid self-supporting, metal-enclosed structure.

b. Switchgear shall be arranged in a two-high breaker construction.

c. Switchgear connections to breakers, potential transformers, and control power transformers shall be made with insulated rigid bus bars.

d. Circuit breaker compartments and switch compartments shall be designed to house 15.0KV removable elements. Primary disconnect contacts shall be silver-plated copper. Grounded metal safety shutters shall isolate all primary connections in compartments when breaker is withdrawn from the connected position.

e. Furnish nameplates as indicated in drawings and specifications. Provide white letters on a black background. Nameplates are to be attached by screws.

2. Exterior Doors

a. Provide access doors for immediate access to low voltage and relay wiring.

b. Provide exterior doors for rear access is required for cable connections.

3. Cubicle Heaters

a. Cubicle heaters shall be provided with thermostatic controls in breaker and termination cubicles to prevent condensation. These heaters shall be in addition to the unit heaters in the building. Thermostat shall be factory set at manufacturer's recommended setting and indicated at each thermostat by permanent marking. All wiring and overcurrent protection shall be factory installed.

4. Finish

a. All metal surfaces shall be thoroughly cleaned, phosphatized, and primed prior to applying a baked enamel or lacquer finish. Interior and exterior finishes shall be standard ANSI 61 gray.

B. Bussing

1. The main bus shall be tin-plated copper and rated as indicated on drawings. Bus bars shall have a continuous current rating based on temperature rise and documented by design tests. All joints are to be tin-plated with a minimum of 2 bolts per joint. Bus bars will be braced to withstand magnetic stresses developed by currents equal to breaker closing and interrupt rating.

2. The ground bus shall be tin-plated copper (minimum 2" x ¼" copper) and extend throughout the assembly.

3. Mimic bussing logic strips shall be provided on front covers of all gear and shall be affixed with screws.

a. Color scheme:

1) Black – Normal power bus

C. Incoming Power Cabling

1. Adequate space shall be provided for power conductor terminations in each cable compartment. Refer to single-line diagram for cable sizing and termination size requirements.

2. Provide tapeless termination covers for each termination.

D. Circuit Breakers

1. General

a. Main breaker shall be synchronized, paralleled, and closed transition back to utility, with disconnect within 100 msec after paralleling.

b. Circuit Breaker ratings shall be as indicated on drawings and breakers of same rating shall be interchangeable. Circuit breakers shall be operated by an electrically charged, mechanically and electrically trip-free, stored-energy spring. A handle shall be provided to manually charge the spring.

c. Remote operation cable attachment device shall be used on each bay door, to allow a safe operating distance while under load.

d. Circuit breakers shall be equipped with secondary disconnecting contacts which shall automatically engage in the connected position.

e. Breaker control voltage shall match the existing switchgear.

f. Auxiliary contacts shall be provided on each breaker. 6 normally open “a” contacts and 6 normally closed “b” contacts. All contacts shall be wired to terminal strips

g. Position contacts shall be provided to indicate the connected or disconnected status of each breaker. 6 normally open “a” contacts and 6 normally closed “b” contacts. All contacts shall be wired to terminal strips.

h. Interface wiring and schematics for interconnection to an existing control system shall be provided.

2. Rackout Equipment

a. Each breaker section shall have a breaker rackout device. When operating the rackout device, the breaker truck shall be self-aligning and held rigidly in the operating position.

b. In the disconnect position the breaker shall be easily removable from the cubicle compartment.

c. Breaker racking shall be possible with the door closed and latched.

d. Breaker racking position shall be externally indicated on each cubicle by flags or other mechanical means.

e. Provide both manual and remote racking devices and storage space for each in the enclosure

f. Interlocks shall be provided to prevent racking in a breaker in the closed position. Springs shall be discharged automatically when breaker is rolled into the connected or disconnected position

g. Provide padlock provisions for each breaker cubicle rackout device when in the connected or disconnected position.

h. Automatic shutters shall cover stab openings when breaker is in the disconnect or test position.

E. Instrument Transformers

1. Current Transformers (CT) ratios shall be as indicated on detail drawings. CT transformer accuracy shall be ANSI standard and shall be rated to withstand the same momentary rating as the selected breaker.

2. Potential Transformers (PT) ratios shall be as indicated on detail drawings. PTs shall be draw-out style with current-limiting fuses and BIL ratings equivalent to the switchgear.

3. Secondary wiring shall be minimum #14 AWG extra-flexible, stranded, tinned-copper control wire rated 600V. Specific wiring required for larger circuits shall be adequately sized and of the same type.

4. Wire ends shall be crimp-type ring terminals.

5. Secondary wiring shall be isolated or adequately protected where passing through primary compartments

6. Shorting terminal blocks shall be provided in CT secondary wiring and all connected devices. All secondary devices shall be capable of being isolated for service by shorting terminal blocks.

7. Secondary wiring shall be marked with numbering/lettering to indicate wire origin and destination. Wire numbers shall not be repeated in sections that are of similar design. A wire number system shall be implemented to prevent redundant numbers and the system shall be indicated on shop drawings.

2.3 PROTECTIVE DEVICES

A. Protective Relays shall be SEL 751 and 751A as indicated on the drawings. Control power shall be either field modifiable 48 VDC/125VDC, with the initial nominal voltage to match the existing system.

B. Provide wiring from the relay input terminals to breaker auxiliary contacts to monitor racking position and status.

C. Provide wiring from the relay input terminals to the breaker open/close circuits.

D. Relays shall be factory configured and pre-tested prior to shipping. Field setting and testing is required in witness of the Engineer and owner.

E. Relays shall be programmed to indicate a scrolling display indicating breaker status open/close, breaker position (connected/disconnected), phase current, phase voltage, and power consumption as a minimum

F. Relay settings and logic shall be provided and programmed prior to product shipment.

2.4 METERING DEVICES

A. Provide one main separate meter system as per metering section of the specifications.

B. Remaining breakers and branches shall use the protective relaying for metering reporting. The protective relays shall be equipped with or connected to communications processors for remote communications of feeder power consumption.

C. Relay metering functionality shall be factory configured, calibrated, and tested prior to shipping.

2.5 ACCESSORIES

A. Provide red and green indicating lamps for each breaker and one white indicating lamp for each lockout relay. Indicating lamps shall be LED type.

B. Provide hand-resettable lockout relays where indicated on the drawings. The lockout relay shall disable all closing of the corresponding circuit breaker until the relay has been reset

C. Provide intermediate class arrestors on each outgoing feeder and where indicated on drawings. Arrestors shall be metal-oxide type with nominal rating of 18kV and an MCOV of 15kV and shall be enclosed in a polymer housing.

D. Provide test switches on relays to permit trip blocking, relay isolation and testing.

E. Lift Truck

F. Manual racking handle

G. Remote racking device including push button, motor operator and 25 feet of cable

H. DC Voltage System

1. General – The DC voltage system shall be expanded with redundancy to include a dual battery charger system, with dual battery racks and a Best Battery Selector system (BBS). The existing battery charger and battery rack shall be expanded to feed both switchgears, and a new second system shall be installed. Each battery charger shall be fed separately and be capable of being safely maintained independent from the other charger. Both systems shall use the existing panelboard for the AC source.

2. Station Batteries and Chargers

a. Battery shall be designed and tested in accordance with applicable current standards.

1) Flooded cell, single cell construction, general purpose type for substation application

2) Battery shell to be impact resistant material

3) Ampere-hour ratings shall be of sufficient rating to provide a minimum 24 hour power to DC system.

4) Operating temperature range shall be 32 degrees F to 100 degrees F

5) Fully insulated flexible copper interconnection cabling shall be provided.

6) Oxide preventative grease shall be applied to all terminals

7) Acceptable manufacturers shall be: Exide, SBS or C&D.

b. Battery Charger

1) Each battery charger shall be minimum 50 amp rated, NEMA 1 rated, and wall-mounted.

2) Battery Charger shall be equipped with a DC voltmeter and DC ammeter, float charging indicator, and high-rate charging indicator on the front panel. The Battery charger shall also be equipped with charger alarm indication and form C contacts for alarm connection.

3) After a 30 second or longer power outage, the battery charger shall apply an equalization charge for a time period adjustable from 0-24 hours

4) Battery charger shall be equipped with an onboard battery check system

5) Each charger shall be capable of charging the required battery amp hours in 8 hours while powering the required DC load.

c. Battery Rack

1) Battery rack shall be a seismically rated design and be coated with two coats of acid resistant paint.

2) Adequate space in battery rack shall be provided to easily maintain batteries

3) Battery Rack shall be located on a spill containment system of high density polyethylene with flame retardant acid absorbing and neutralizing pillows.

2.6 TESTING

A. The switchgear equipment and circuit breakers shall receive the following minimum factory production test as listed below. Any testing performed that are not listed below should be noted:

1. Equipment

a. Low frequency dielectric test

b. Grounding of instrument cases

c. Control wiring and device functional tests

d. Polarity verification

e. Sequence of operation tests

f. Low frequency withstand voltage test on major insulation components

g. Low frequency withstand test on secondary control wiring.

2. Breakers

a. Coil check test

b. Clearance and mechanical adjustment

c. 300 electrical and mechanical operation test

d. Timing test

e. Conductivity of current path test

f. Hi-pot testing

g. Vacuum bottle integrity test

B. Factory test copies shall be provided to the Engineer to verify completion of required testing.

2.7 FACTORY WITNESS TESTING

A. At the factory, the switchgear manufacturer shall perform testing on all of the switchgear as detailed in this specification. The switchgear and associated controls shall be tested as required to verify the proper operation of each component and demonstrating compliance with the specification. The cost of travel, lodging, and expenses for the Owner and (2) Owner's representatives to attend the factory witness test for (3) days shall be included as a part of the proposal. Factory witness testing shall be performed by

the same personnel that performed factory testing where possible. Notify the owner and owner's representative a minimum of 2 weeks in advance for scheduling of the factory witness test

B. The switchgear shall be completely assembled, wired, adjusted and tested.

C. After a visual inspection, the following operational tests shall be performed:

1. Operate all circuit breakers in the connected and test positions. Interlock checks to verify spring discharge upon racking in a closed breaker shall also be tested.

2. Check alignment and operation of racking mechanisms of each cubicle by removing and reinstalling each circuit breaker

3. Check spring operation of each breaker by tripping, closing and tripping each breaker after removal of control power.

4. Dielectric testing

5. Simulation testing of protective relays

6. Record all 48VDC/125VDC power loads during system tests to verify battery plant testing

7. Relay metering verification testing.

8. Sequence of operation testing including a simulated test stand to mimic operation of breakers in wind and diesel generator conditions.

9. Alarm annunciation testing

10. All relay testing including relay test switch functionality, breaker contact and wiring to relay.

11. The manufacturer shall submit in writing when all systems have been installed, set up, programmed, and verified prior to Factory Witness Test.

2.8 FINISH

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Verify adequate spacing and clearances to install switchgear

B. Verify concrete pads are level and uniform

C. Perform inspection of switchgear for shipping damage and verify that all shipping Bill of Materials are accounted for

D. Verify field measurements prior to switchgear build during the shop drawing review process against locations shown on the design drawings. Any major issues shall be brought to the attention of the design engineer and switchgear manufacturer prior to release of order.

E. Installer shall have a minimum of 5 years documented experience in installing medium voltage metal clad switchgear.

F. Installer shall coordinate closely with manufacturer and follow manufacturer installation instructions.

3.2 FIELD QUALITY CONTROL

A. The manufacturer shall provide field start up service and owner training for the switchgear installation

B. The manufacturer shall inspect installation of anchoring, alignment, grounding, and field modifications and verify compliance with manufacturer recommendations.

C. All electrical connections shall be verified with a calibrated torque wrench tightened to manufacture instructions

D. The installing contractor shall include complete acceptance testing of the equipment. Acceptance testing shall be performed by an independent testing company approved by the Owner. Testing shall be complete and in accordance with NETA Acceptance Testing Specifications for Electrical Equipment and Systems, ATS-2013, sections:

1. 7.1 Switchgear and switchboard assemblies

2. 7.6.3 Circuit breakers, vacuum, medium-voltage

3. 7.9 Protective Relays

4. 7.10 Instrument Transformers

5. 7.11 Metering Devices

6. 7.13 Grounding Systems

7. 7.19.2 Surge arrestors, medium voltage and high voltage surge protection devices

3.3 CLEANING

A. Clean all interiors of switchgear, wiring enclosures, and switchgear enclosure interiors.

END OF SECTION

SECTION 26 13 19 – SF6 LOAD BREAK SWITCHES – 15 KV

PART 1 - GENERAL

1.1 WORK INCLUDED:

A. Provide UL listed deadfront, sealed construction, fused or non-fused load break switches utilizing sulphur hexafluoride gas (SF6) as the arc control medium.

B. Refer to drawings for switch configurations and fusing requirements. Switches shall be manually operated, three-phase unless otherwise noted on drawings.

1.2 RELATED WORK:

A. Section 26 05 00: Basic Materials and Methods

B. Section 26 05 33: Raceways

C. Section 26 05 19: Wires and Cables

1.3 QUALITY ASSURANCE:

A. Equipment shall meet or exceed the following design standards:

1. ANSI C37.71 Standard for subsurface load interrupter switches

2. ANSI C37.72 Standard for padmount load interrupting switches.

3. ANSI/IEEE 386 Standard for separable connectors and bushings

4. ANSI/NFPA 70-National Electrical Code, latest edition

5. UL-Underwriter's Laboratories, Inc.

6. NEMA-National Electrical Manufacturers Association

B. The installation, connection, testing and performance of the equipment shall be the responsibility of one contractor.

C. Manufacturer: company specializing in load break switch manufacture with five years documented experience and a manufacturer’s representative located within 50 miles of the University.

1.4 SUBMITTALS:

A. Submit according to General Conditions, Division 01, and Section 26 0500.

B. Submit shop drawings showing outline dimensions, switch and enclosure construction, weight, mounting provisions, one line diagram and electrical ratings, and relay setting options to the Engineer.

1.5 OPERATION AND MAINTENANCE DATA:

A. Provide as-installed wiring and interconnection diagram of each switch.

B. Provide fuse replacement and equipment lubrication instructions.

1.6 STANDARDS:

A. Equipment design standards: In accordance with ANSI C37.71, Standard for subsurface load interrupter switches; ANSI C37.72, Standard for padmount load interrupting switches; ANSI/IEEE 386, Standard for separable connectors and bushings; ASTM D-2472-69 specification of commercial type electrical grade SF6.

1.7 QUALITY ASSURANCE:

A. The installation, connection, testing and performance of the equipment shall be the responsibility of one contractor.

B. Manufacturer: company specializing in load break switch manufacture with five years documented experience and a representative located in Portland.

1.8 DELIVERY, STORAGE AND HANDLING:

A. Accept equipment on site and inspect for shipping damage. Store equipment in accordance with manufacturer's instructions.

B. Protect equipment stored on site from weather and moisture by maintaining factory covers and suitable weatherproof covering.

1.9 EXTRA MATERIALS:

A. Special tools: specific purpose tools required for routine maintenance or replacement of fuses shall be delivered with equipment.

B. Provide SF6 refill cylinder with regulator, valves and hose for connection to the fill valve of the switch.

1.10 WARRANTY:

A. Provide one year warranty for all equipment and workmanship, dated from the substantial completion date of the contract, not the delivery date of the material.

B. Manufacturer and installer jointly and separately shall guarantee the equipment to be free from defects in operation for the specified period, beginning from the date of Owner's acceptance.

C. Guarantee covers repair or replacement of equipment which fails to perform as specified during the warranty period. Repair rather than replacement will be accepted only if it does not compromise the longevity of the equipment.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. Provide products of one of the following:

S&C Vista
Approved equal

Other manufacturers' equipment may be considered if the proposed substitute equipment data is submitted to the engineer at least 10 working days prior to bid date and sufficient data is submitted to verify conformance with the specifications.

2.3 PAD STYLE SF6 EQUIPMENT

A. The pad style gear shall consist of a painted steel enclosure, dead front, containing interrupter switches, with integral load interrupters, and the necessary accessory components, all completely factory assembled and operationally checked. The switching contacts shall be contained within a dielectric medium.

B. Windows shall be provided to view trip flags.

C. Switches shall have a single blade per phase and shall be externally operable. A quick-make, quick-break mechanism is mandatory.

D. Interrupter switches shall have a two-time duty-cycle fault-closing rating equal to or exceeding the short-circuit rating of the integrated pad-mounted gear assembly. The integrated pad-mounted gear-interrupter switches, and enclosure--shall safely withstand the effects of closing, carrying, and interrupting all possible currents up to the assigned maximum short-circuit rating of the pad-mounted gear.

E. Over current protected ways shall be Vacuum Fault Interrupters. Provide settings as indicated by the Engineer.

F. Provide switches with copper alloy contacts and copper bus.

H. Switch shall automatically prevent single phasing. Manual control of the load break operation shall be possible.

I. Provide switch with dip switches to adjust trip level on site.

J. Switches shall have front access wiring.

2.4 PAD EQUIPMENT RATINGS:

A. Voltage: 12.5KV Nominal, 110KV BIL.

B. Main Bus: 600 Amps continuous.

C. Switched ways shall have a minimum of 20,000 RMS asymmetrical breaking and 12,000 amps RMS fault closing. VFI ways shall have standard 12,000 amp rating.

2.5 PAD EQUIPMENT BUSHINGS

A. Equip each switch with entry terminations suitable for standard 600 amp dead break molded elbows for incoming lines. Equip each Vaccuum Fault Interrupter way with entry terminations suitable for standard 200 amp load break molded elbows.

B. Provide parking stands adjacent to each entry bushing.

PART 3 - EXECUTION

3.1 GENERAL

A. Do not proceed with installation until approved shop drawings have been received.

3.2 EXAMINATION:

A. Verify that site is ready for installation and connection of equipment. Advise engineer in writing if proposed location is not suitable.

B. Beginning of installation means acceptance of existing conditions.

3.3 INSTALLATION:

A. Install equipment in accordance with equipment manufacturer's instructions and in conformance with the drawings, specifications and reviewed shop drawings.

3.4 COMMISSIONING AND TESTING:

A. Factory testing: switches shall be completely fabricated and tested at the factory during manufacturer and upon completion.

B. Field testing: Follow recommendations of the National Electrical Testing Association (NETA), latest version.

C. Set fuse curves and relays according to the settings provided by the Engineer.

D. Verify that switch operates properly. All switches shall be field tested and the test shall be witnessed by the Engineer, and/or the owner. A Factory Representative shall demonstrate and provide training on the equipment.

E. Verify that SF6 gas pressure level is as directed by manufacturer and switch operates properly. If SF6 has leaked out, determine cause and repair, or replace switch in its entirety.

END OF SECTION

SECTION 26 24 16 - PANELBOARDS

PART 1 - GENERAL

1.1 WORK INCLUDED:

A. Provide all branch circuit panelboards as herein specified and shown on the drawings.

1.2 SUBMITTALS:

A. Submit complete and descriptive shop drawings indicating dimensions and compliance with the specifications herein. Submit in accordance with the General Conditions, Division 01, and Section 26 05 00.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. Square D, Siemens, General Electric, Cutler-Hammer/Westinghouse

B. Requests for substitution of other products will be considered if submitted in accordance with the General Conditions, Division 01, and Section 26 05 00.

2.2 EQUIPMENT:

A. Panels shall be factory pre-assembled using bolt-on circuit breakers, equivalent to Square D NQOD series. Separate feeder lugs shall be provided for each feeder conductor.

B. Breakers in branch panelboards shall be not less than 3/4 inch on centers. Each breaker shall be securely fastened to prevent movement and trims shall fit neatly and tightly to the breaker assembly. Two and three pole breakers shall be single breaker assembly rather than two or three single pole breakers with the handles tied together externally.

C. Panel finish shall be a flat, light gray finish suitable for painting over or being left with factory finish. Flush mounted panels in finished walls shall be painted to match wall, paint and paint preparation to be as specified by Architect. Panel covers to be painted off wall, then installed over painted wall surface. Trims to be separately packed and protected from scratching and marring. Refer to labeling requirements in 26 05 00 Basic Materials and Methods.

D. Panelboard trims to have concealed trim screws and door hinges, and a flush stainless steel cylinder lock with catch and coil spring loaded door pull equivalent to Square D "Mono-Flat". All panels shall be keyed alike.

E. Where grounding conductors are shown or specified, provide each panel and distribution center with grounding bus to which the grounding conductors shall be connected, each having its own terminal or lug.

F. Where Isolated Grounding (IG) conductors are shown or specified, provide each panel and distribution center with an Isolated Grounding bus to which the IG conductors shall be connected, each having its own terminal or lug. The IG grounding system shall be fully separated and insulated from the IG receptacle to the System Grounding Electrode. Provide a second ground bus bonded to the panelboard can for termination of conduit and equipment bonding conductors.

G. Panelboards rated 400 amps or less shall not exceed 6" depth.

H. Provide fully rated equipment greater than or equal to the interrupting capacities indicated on the drawings.

I. Provide all copper bus bars, 100% rated neutral bus, ground bus and isolated ground bus where indicated. Lugs shall be rated for copper only, CU-AL rated lugs shall not be allowed.

J. Provide breaker tie handles in 2 pole and 3 pole configurations for all grouped multiwire branch circuits to allow grouped disconnecting means. Verify quantity with contractor.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Breaker handle guards shall be provided on each circuit supplying obviously constant loads to prevent accidental shutting off. Such loads are refrigeration, contactor controlled circuits, freeze protection, etc.

B. Furnish and install three spare one inch conduits from the top of each recessed panel, to an accessible point above the ceiling.

C. Care shall be taken to terminate ground conductors from isolated ground receptacles only on the isolated ground bus in a panel. Do not terminate bonding conductors on an isolated ground bus.

D. Each multiwire branch circuit shall be provided with breaker tie handles such that all ungrounded conductors will be simultaneously disconnected as per NEC 210.4 (B). Provide 2 pole and 3 pole breaker tie handles in sufficient quantity for all grouped circuits.

E. Group the ungrounded and grounded conductors for multiwire branch circuits in at least one location inside the panelboard with wire ties or similar means per NEC 210.4 (D).

END OF SECTION

SECTION 26 27 26 – SWITCHES & RECEPTACLES

PART 1 - GENERAL

1.1 WORK INCLUDED:

A. Provide all switches, receptacles, and other devices as herein specified and shown on the associated drawings.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. Bryant, Arrow-Hart, Eagle, LaGrande, General Electric, Leviton, Hubbell are acceptable.

2.2 MATERIALS:

A. The following list of wiring devices covers the most commonly specified items and establishes the grade of device. Should the Drawings indicate a device other than those listed herein without reference to catalog number, such device shall be of the same grade and manufacturer as like devices.

Single Pole Switches	Hubbell #1221
Duplex Receptacles - 20 amp Where required by Code and/or indicated on drawings	Hubbell #5362
Hospital-grade Duplex Receptacle	Hubbell #8300
Safety Duplex Receptacle	Hubbell #HBLSG 63H
Duplex Receptacles-Isolated Ground	Hubbell #5362-IG, Orange
Switch with Pilot	LaGrande #20AC1
Dimmers	Lightolier, Neptune Momentum series

B. All wiring devices and plates to be specification grade. Receptacles shall be mounted vertically with the ground pin down unless otherwise noted.

C. Color of devices and plates to be selected by Architect. Provide nylon plates in finish areas. Wood paneled walls shall have brown devices and plates. Restrooms, and food preparation areas to have 302 stainless steel plates. Receptacles fed by emergency circuits shall have red devices with "EMERGENCY POWER" engraved in white letters on a red nylon plate with panel and circuit designation engraved on plate. Receptacles fed by UPS circuits shall have yellow devices with "UPS POWER" engraved in white letters on a red nylon plate with panel and circuit designation engraved on plate.

D. Flush floor receptacles to be duplex and to have brass, hinged flap lids. Provide carpet flanges in carpeted floors. (See 26 0500, 2.4, E.)

E. Wet location and/or weatherproof receptacles shall be in a weatherproof enclosure, the integrity of which is not affected when the receptacle is in use (attachment plug cap inserted), UL labeled and listed “Suitable For Wet Locations While In Use”. Provide enclosure with stainless steel screws, gasket between enclosure and mounting surface and between cover and base, clear impact resistant UV stabilized polycarbonate as manufactured by TayMac Corporation or accepted equivalent.

PART 3 - EXECUTION

3.1 GENERAL:

A. Provide a separate GFI type receptacle for each receptacle noted on plans as GFI. Standard receptacles fed from an up-steam GFI type receptacle are not acceptable.

B. Install outlets and switches in a neat manner.

C. Extend mudrings to flush out with surrounding wood panels and walls.

D. Faceplates, devices, and boxes shall be square with floor, and door lines.

E. Devices to be installed flush with faceplate.

3.2 LABELING:

A. Where switches control remote lighting or power outlets, or where switches in the same outlet (two or more) serve different purposes, such as light, power, intercom, etc. or different areas, such as corridor and outside, furnish engraved plates with 1/8 inch black letters indicating function of each switch or outlet.

END OF SECTION

SECTION 26 43 00 – SURGE PROTECTIVE DEVICES

PART 1 - GENERAL

1.1 WORK INCLUDED:

A. Furnish all labor, materials, equipment and services necessary for and incidental to the installation of the surge protective device (referred to as SPD herein and/or TVSS on the drawings) components at locations shown on the plans.

1.2 QUALITY ASSURANCE:

A. The SPD shall be UL Listed as a surge protective device, category C, UL 1449 Third Edition. All UL 1449 test data shall be provided with submittal.

B. The SPD shall bear suppressed voltage rating issued by UL, and the units shall be tested in accordance with ANSI/IEEE C62.41-2002, Category C, 20kV/10kA, 8x20 uS and 1.2x50 uS Combination Waveform and .5uS - 100kHz Ring Wave with a minimum of 10 sequential impulses delivered directly into the SPD at a maximum of sixty second intervals for each waveform.

C. Manufacturers Qualifications: Only firms regularly engaged in the manufacture of SPD products for category C (ANSI/IEEE C62.41), and whose products have been providing satisfactory service for not less than five years, shall be considered. Manufacturer qualifications shall be provided as part of the submittal.

D. The SPD must be capable of surviving 1000 sequential surges without failure, using IEEE test procedures established in C62.45.

E. The SPD device must have MOV surge devices, installed with full rating indicated between Phase to Neutral, Phase to Ground, and Neutral to Ground, and be capable of handling a minimum surge current as follows:

Panel/Switchboard Size Equal or greater than (A):	3000	2000	1200	800	225	100
Mode:	kA/Mode					
Line to Neutral	250	200	150	100	80	50
Line to Ground	250	200	150	100	80	50
Neutral to Ground	250	200	150	100	80	50

1.3 SUBMITTALS:

A. Submit complete and descriptive shop drawings in accordance with the General Conditions, Division 1, and Section 26 05 00.

B. Submit all related SPD Specifications and drawing information requested in this document and U.L. 1449 Third Edition surge suppression ratings for the SPD. In order for a SPD system to be considered, all responses to information requested in this specification must be provided in writing. If a manufacturer cannot comply with any portion of this specification, this must be stated in the reply and the reason for non-compliance shall be provided.

C. Submit operation and maintenance data in accordance with the General Conditions, Division 1, and Section 26 05 00.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. Provide products of one of the following manufacturers:

1. Liebert
2. LEA International
3. Current Technologies
4. Advanced Protection Technologies
5. Intermatic Inc.
6. GE Power Quality
7. Cutler Hammer Clipper
8. Square D
9. Siemens

B. Requests for substitution of other products meeting all specification requirements herein will be considered if submitted in accordance with the General Conditions, Division 1 and section 16050.

2.2 SPD EQUIPMENT:

A. The SPD shall be suitable for application in category C environments as described in ANSI/IEEE C62.41. The SPD shall be of parallel design and provide protection from Line to Ground, Line to Line, Line to Neutral, and Neutral to Ground.

B. The SPD shall be compatible with the electrical system voltage, current, configuration and intended application.

C. The SPD maximum continuous operation voltage (MCOV) shall be capable of sustaining 100% of the nominal RMS voltage continuously without degradation.

D. The SPD shall only use solid state clamping components connected in parallel with the supply to limit the surge voltages. Clamping components shall be installed in 7 modes. Four mode SPD devices are not acceptable.

E. For Monitoring of SPD's Provide:

1. Visual and audible indication with disable switch for properly performing protection.

2. Provide a surge counter.

F. House in the appropriate NEMA rated enclosure, SPD shall not be integrated into panelboards or switchboards.

G. SPD shall be repetitive in nature such that failure of a single component within the SPD (i.e. MOV, fuse, etc) does not leave the electrical system unprotected.

H. All SPD's installed in front of the main service disconnect(s) as indicated on the drawings shall be provided with an integral disconnect and the SPD shall be located next to the main service disconnect(s).

I. Warranty shall be for full replacement without pro-rating value, for a minimum period of 10 years.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Ship with complete installation instructions which are to be followed in detail. The manufacturer's representative is to be contacted and is to supervise the installation.

B. Installation shall comply with all applicable State and National Electrical Codes, including NEC Articles 240, 250, 310 and 285. Utilize the panelboard/switchboard circuit breaker to provide overcurrent protection and a means to disconnect power from unit. Fuses shall not be utilized for the SPD overcurrent protection unless specifically indicated on the drawings and if utilized shall be of the Time Delay type rated for the available fault current at the location of installation.

C. Phase, neutral and ground leads of installed SPD must be grouped and twisted together up to the point of connection at the bus or overcurrent device. Lead lengths must be as short as possible, avoiding bends where possible. Lead lengths greater than sixteen inches or sharp bends in leads shall not be permitted, where lead lengths greater than sixteen inches cannot be avoided high performance low impedance cable equivalent to Current Technology "High

Performance Interconnect (HPI) SPD connection system" shall be used while maintaining the shortest lead lengths possible, wire size shall be as indicated on the drawings. Lead length is measured from switchboard bus or breaker to point of connection to SPD device.

D. Conductors must terminate with compression type lugs.

E. Mount so that suppressor indicator lights will be clearly visible after installation.

F. Circuit breaker shall be exclusively utilized for the SPD device.

G. Raceway from SPD to switchboard shall consist of rigid steel conduit with double locknuts and grounding bushings connected to switchboard ground.

H. Overcurrent protection sizing shall be as per manufacturer's instructions. Conductor sizing shall be based on NEC requirements.

3.2 COMMISSIONING AND TESTING:

A. Contractor shall provide for access and inspection of installed surge protective devices by the Architect/Engineer, and the Owner. Correct all malfunctions.

END OF SECTION

SECTION 26 51 00 - LIGHTING

PART 1 - GENERAL

1.1 WORK INCLUDED:

A. Provide light fixtures with lamps and accessories as herein specified and shown on the drawings.

1.2 QUALITY ASSURANCE:

A. If the catalog number of a specified fixture should conflict with the fixture description or the general lighting specifications, such conflicts shall be brought to the attention of the Architect prior to bidding.

1.3 SUBMITTALS:

A. Submit product data and shop drawings for fixtures, ballasts, and lamps in accordance with the General Conditions, Division 1, and Section 26 05 00.

B. Verify that fixture description matches that which is indicated by the specified catalog number.

C. All features mentioned in the fixture list shall be marked on the submitted items.

D. Submit Operation and Maintenance data in accordance with the General Conditions, Division 1, and Section 26 05 00.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. See Luminaire Schedule for acceptable manufacturers.

B. Requests for substitution of other products will be considered if submitted in accordance with the General Conditions, Division 1, and Section 26 05 00.

C. Substitution requests for fixtures equal to those specified shall include complete construction and photometric data including, if applicable, candlepower distribution curve, spacing to mounting height ratio, table of coefficients of utilization, isofootcandle curve, ANSI beam spread classification, efficiency, etc.

D. Submittals and substitution requests for fluorescent fixtures shall include the sheet metal gauge of the housing and the lens thickness, material, and pattern.

2.2 MATERIALS:

A. Polystyrene lenses and lenses less than 0.125 inches nominal thickness shall not be permitted unless otherwise noted.

B. Provide luminaires with Area Coverage, damp, or wet label if required for the application indicated.

2.3 BALLASTS:

A. All ballasts shall be capable of providing reliable operation of the lamps at the lowest temperature normally encountered. The contractor shall confirm that the ballasts are appropriate for the ambient conditions.

B. The contractor shall verify the ballast voltage prior to submittal.

C. Ballasts deemed excessively noisy shall be replaced without cost to the Owner.

D. PREMIUM T8 BALLASTS – INSTANT START: Premium T8 fluorescent ballasts, unless noted otherwise on Light Fixture Schedule, shall be instant start electronic type; ballast data as follows:

UL listed and CSA certified.
Low wattage, ballast factor of 0.75 to 0.78
Similar light output with Premium lamp to standard T8 ballast and lamps.
Recognized Testing Laboratory listed, thermally protected, resetting, Class P, non-PCB, sound rated A.
Operate lamps at a frequency of 40KHz or higher with no detectable flicker.
Total Harmonic Distortion (THD) of 10% or less.
Power factor equal to or greater than 98%.
Minimum lamp starting temperature of 50 degrees F.
Meet all current Federal, State and Power Co. efficiency and efficacy standards, and rebate program requirements.
Meet all current ANSI, IEEE, and FCC regulations for EMI/RFI, harmonic distortion, and transient protection.
Provide extended lamp life as stated by lamp manufacturer.
Minimum 5 year ballast and replacement labor warranty by manufacturer.
Ballast manufacturer's data must be included with lighting fixture submittals.
Compatible with occupancy sensor switching.

Approved manufacturers: Advance (Centium or Optanium), Osram Sylvania, Magnetek, or approved.

E. STANDARD COMPACT FLUORESCENT BALLASTS – PROGRAMMED START: Compact fluorescent ballasts, unless noted otherwise on Light Fixture Schedule, shall be programmed start electronic type; to operate 4 pin compact fluorescent lamps, ballast data as follows:

UL listed and CSA certified.

Full light output.
Dual voltage rated 120/277
Capable of operating more than one lamp wattage for PL-T triple tube applications
Recognized Testing Laboratory listed, thermally protected, resetting, non-PCB, sound rated A.
Operate lamp(s) at a frequency of above 40 kHz.
Total Harmonic Distortion (THD) of less than 10%.
Programmed start.
Power factor equal to or greater than 98%.
Maximum lamp crest factor 1.7.
Minimum lamp starting temperature of 0 degrees F.
Meet all current Federal, State and Power Company efficiency and efficacy standards, and rebate program requirements.
Meet all current ANSI, IEE, and FCC regulations for EMI/RFI, harmonic distortion, and transient protection.
Provide normal lamp life as stated by lamp manufacturer.
Minimum 5 year ballast and replacement labor warranty by manufacturer.
End-of-life detection and shut-down circuitry that meets proposed ANSI/IEC standards.
Ballast manufacturer's data must be included with light fixture submittal.

Approved manufacturers: Advance, Osram Sylvania, Magnetek, Howard Industries, or approved.

Provide emergency battery/inverter packs at fixtures indicated on plans.

1. T8 or T5 fluorescent emergency battery/inverter pack shall be capable of operating lamp(s) at a minimum of 1100 lumens, or at the lumen rating listed on the Light Fixture Schedule (whichever is greater), for a minimum of 90 minutes.

2. For compact fluorescent or incandescent sources, the emergency battery/inverter pack shall be capable of operating the lamp(s) at 100% lumen rating of the lamp(s) for a minimum of 90 minutes.

3. Emergency battery/inverter packs shall be UL listed and warranted for a minimum of 5 years for the T8 or T5 lamps and 2 years for the compact fluorescent or incandescent lamps.

4. Approved Manufacturers: Bodine, Iota, Lithonia or as listed on the fixture schedule.

F. HID ballasts shall be as follows:

1. High Pressure Sodium (HPS):

a. High power factor, normal ambient, 180 degrees C insulation class, with capacitor and ignitor.

b. Auto transformer type for 50 watt lamps.

c. Constant wattage auto transformer type for lamps 70 watt and above.

2. Metal Halide (MH):

a. High power factor, normal ambient, 180 degrees C insulation class.

b. Auto transformer with capacitor and ignitor for lamps 150 watt or less.

c. Constant wattage autotransformer with capacitor for lamps above 150 watts.

3. Pulse Start Metal Halide (PSMH):

a. Where available as standard products, provide pulse start metal halide ballasts for maximum energy savings.

G. Three or four lamp fluorescent fixtures located within 10 feet of each other, and arranged for 2 or 3 level lighting shall have master/slave ballasts wired in such a manner that a single switch shall not operate the outer lamps in some fixtures, and the inner lamps in others. One ballast shall serve outer lamps and the other shall serve inner lamp(s).

L. In indoor locations other than dwellings or hazardous locations, fluorescent luminaries that utilize double-ended lamps and contain ballast(s) that can be serviced in place shall have a quick disconnecting means factory installed, internal to the luminaire, and accessable from the ballast housing. The quick disconnect shall simultaneously break all of the supply conductors to the ballast, including the neutral. The line side terminals of the disconnect shall be guarded.

2.4 LAMPS:

A. Provide Premium grade, high performance T8 lamps, low mercury TCLP complaint (green ends), 3100 lumens, 3500°K, CRI of 82.

B. T5, Biaxial, and compact fluorescent lamps shall be 3500°K type with a minimum CRI of 82, unless otherwise noted. Provide low mercury TCLP compliant lamps (green ends) where available as standard products (Philips Alto series or equal).

C. Metal Halide high intensity discharge lamps shall be either coated or clear as recommended by the fixture manufacturer. Provide pulse start lamps for Metal Halide fixtures requiring pulse start. Provide minimum CRI of 65.

D. Provide Ceramic Metal Halide (Philips Master Color) with minimum CRI of 80 for display type lamps. Provide Low mercury TCLP compliant (green end) where available as standard product.

E. For Metal Halide lamps, provide Base Up, or Horizontal rated lamps for maximum lumen output. Universal Burn lamps are not acceptable.

F. High Pressure Sodium high intensity discharge lamps shall be low mercury TCLP compliant where available as standard products, and have an average rated life of 24,000 hours.

G. All incandescent lamps shall be 130 volt, inside frosted unless otherwise noted (except Halogen).

H. Acceptable lamp manufacturers are Venture, Osram/Sylvania, Philips, and General Electric.

I. All lamps and fixtures shall be in proper operation at the time of acceptance.

J. SPARE LAMPS: Provide ten percent spare lamps, with a minimum of two, for each size and type used.

2.5 POLES:

A. Each pole shall have adequate strength and rigidity to withstand not less than 100 mph winds without damage to the poles and attached fixtures and lamps. Pole bases shall be equipped with handholes with matching covers, and base cover.

B. Anchor bolts shall be hot-dip galvanized after fabrication and threads cleared. Nuts, washers, and other hardware and fittings shall be corrosion resistant alloy material of adequate strength. Indicated pole heights are above the top of the concrete base.

C. After the poles have been installed, shimmed and plumbed, grout the spaces between the pole bases and the concrete base with non-shrink concrete grout material.

D. Provide ground rod for poles installed on grade, attached to pole.

E. Provide fuse clips located in handhole for each fixture head circuit.

2.6 JUNCTION BOXES:

A. Lighting junction boxes to be a high density polymer concrete 10,000lb application with a lockable lid.

B. Acceptable Manufacturers are Synertech, Oldcastle Precast, or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Luminaires installed under this work shall be properly and adequately supported from the building structure except where ceiling construction or other provisions are specifically designed to support the fixture units. Fixture support systems shall provide a safety

factor of four. This shall apply to chains, hangers, anchors, clamps, screws, and all other hardware and appurtenances associated with the support system.

B. Fixture supports shall provide proper alignment and leveling of fixtures, and shall be arranged to maintain the alignment at all times. The final decision as to adequacy of alignment shall be given by the Architect.

C. All light outlets shall be supplied with a fixture. Outlet symbols on the drawings without a type designation shall have a fixture the same as those used in similar or like locations.

D. Fixture stem or chain lengths for industrial reflector or bare lamp strip fixtures shall be appropriate for the space and for coordination with other work such as ducts and piping. Provide swivel hangers for stem-hung fixtures.

E. Fixtures shall be left clean at the time of acceptance of the work and every lamp shall be in operation. The responsibility for cleaning or protecting fixtures from dirt, dust, paint, debris, etc. shall rest with the Contractor performing this division of work.

F. Prior to the purchase of any luminaire, the finish shall be verified with the Architect and the voltage shall be verified based on the panelboard voltage.

G. Fixtures of a given description may be used in more than one type of ceiling. Consult the Architectural Reflected Ceiling plan to obtain this information. Some ceiling types may have changed immediately prior to bidding or by addenda or change order and the changes may not be reflected in the fixture list or fixture designations as shown on the plans. The contractor shall compare the electrical plans with the reflected ceiling plan and confirm that the specified fixtures are compatible with the ceiling system prior to ordering.

H. Provide seismic support wires for all recessed fixtures where ceiling framing is not designed for fixture support.

I. Do not mount fluorescent or H.I.D. fixtures within 12" of any cable tray or telecommunications cable.

3.2 COMMISSIONING AND TESTING:

A. Contractor shall provide for access and inspection of installed lighting fixtures by the Architect/Engineer, owner and commissioning agent. Correct all malfunctions.

END OF SECTION

DIVISION 31

EARTH WORK

SECTION 31 05 10

BOUNDARY MARKERS AND SURVEY MONUMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for installing boundary markers and survey monuments.

1.2 PERFORMANCE REQUIREMENTS

A. Identify the land surveyor who set the marker plates and reference marks.

B. For vertical control datum use Mean Sea Level datum adjusted by United States Coast and Geodetic Survey for the location of survey.

C. Vertical Accuracy: 3rd order.

D. Make all individual tape measurements to the nearest 0.01 of a foot, with tape corrections for temperature, sag, suspension, etc. noted on all field notes requiring such measurements.

E. Horizontal Accuracy:

1. 1:10,000 minimum for urban areas.
2. 1:20,000 minimum for metropolitan areas.

1.3 SUBMITTALS

A. Survey notes and drawings showing:

1. All monuments found, set, reset, or replaced, describing their kind, size, and location and giving other data relating thereto.
2. Lines of survey, concrete structures containing reference marks, types of marks installed, distances and angles from monument referenced.
3. Witness monuments, basis of bearings, bearings, length of lines to monuments or corners witnessed and scale of drawing.
4. Errors of closure and method of adjustment.
5. Memorandum of oaths and certificates.
6. Narrative describing purpose of survey.
7. Any other data necessary for the interpretation of various items and locations for points, lines, and areas shown.

B. Copies of plats filed with the County Recorder.

1.4 **QUALITY ASSURANCE**

A. Use a land surveyor who complies with Utah licensing law and who is acceptable to OWNER to supervise setting or resetting of monuments and boundary markers.

B. Make surveys in conformance with accepted practice of land surveying and comply with all pertinent Laws and Regulations of land survey regulatory agencies and authority having jurisdiction.

PART 2 PRODUCTS

2.1 **MONUMENT**

A. Monument Post: Minimum three (3) feet long, precast or cast-in-place concrete. Make exposed surface of finished monument posts uniform, even texture, and free of holes, cracks, and chipped edges.

B. Marker Plate: Brass or bronze or as indicated.

2.2 **FRAME AND COVER**

A. Asphalt coated, heavy duty, cast iron, Section 05 56 00.

2.3 **LOT LINE WITNESS MARKER**

A. Brass surveyor's tag or brass nail set in a lead filled hole in concrete.

2.4 **REBAR CORNER MARKER**

A. No. 5 rebar, at least 18 inches long with the top fitted with a nonferrous survey cap and stamped with land surveyor's registration number.

2.5 **PIPE CORNER MARKERS**

A. One (1) inch internal diameter galvanized steel pipe at least 18 inches long, or two (2) inches internal diameter galvanized steel pipe at least 36 inches long.

B. Fit pipe with concrete or mortar plug, tagged with surveyor's license number.

C. Fix tag in concrete or mortar plug with a one (1) inch minimum long bent brass brad.

2.6 **FIELD NOTE PAPER**

A. Twenty (20) pound bond paper minimum with format of documents acceptable to OWNER.

2.7 **CONCRETE**

A. Cast-in-place: Class 4000, Section 03 30 04, or

B. Precast: Class 5000, Section 03 40 00.

PART 3 EXECUTION

3.1 **PREPARATION**

A. Locate and preserve utilities, Section 31 23 16.

B. Excavation, Section 31 23 16.

3.2 **HORIZONTAL CONTROL**

A. Set base horizontal ground control upon a minimum of two (2) United States Coast and Geodetic Survey triangulation stations or equivalent, and tie to the Lambert Conformal Conic Projection for establishment of the State Plane Coordinate System with local datum adjustment within the Project area.

3.3 **BEARING BASE**

A. Refer all directional measurements to one "bearing base". Actual measurements may be equated to bearings and linear measurements shown on any record (i.e., plat, official map, description, or approved field notes of lines resurveyed that are shown on such records used in the survey).

3.4 **TIE TO EXISTING MONUMENTS**

A. Tie into a monument which has State Plane Coordinates if the monument is within 1/2 mile of the proposed survey site or at a selected location.

3.5 **CORNER MARKERS**

A. Site Boundary: Install pipe corner markers.

B. Lot Boundary: Install rebar corner markers for lot corners. Do not use rebar where pipe corner markers are installed as a boundary marker and a corner marker.

3.6 **LOT LINE WITNESS MARKER**

A. Witness lot lines by installing 1/2 inch surveyor tags in sidewalk. If sidewalk does not exist, install tags in curb or mass concrete.

3.7 **MONUMENTS**

A. Locate monument post so reference point falls within 1 inch diameter circle in the center of marker plate. Install marker plate in survey monument post before the concrete has acquired its initial set.

B. Compact backfill to 95 percent or greater relative to a modified proctor density, Section 31 23 26.

C. Set top of frames and covers 1/4 inch lower than Pavement surface. Recess marker plate a minimum of four (4) inches below cover.

D. Install monument so frame and cover does not contact monument or marker plate.

3.8 **DAMAGED MONUMENTS**

A. Replace survey control monuments that are disturbed or destroyed by CONTRACTOR.

B. If OWNER allows replacement of lost or destroyed survey control monuments, use a licensed land surveyor to re-establish control monuments based upon original survey control.

3.9 **REFERENCE MARKS**

A. Section 01 71 34.

END OF SECTION

SECTION 31 05 13
COMMON FILL

PART 1 GENERAL

1.1. **SECTION INCLUDES**

A. Common fill material.

1.2 **REFERENCES**

A. **ASTM Standards**:

C 136 Sieve Analysis of Fine and Coarse Aggregates.

D 448 Classification for Sizes of Aggregate for Road and Bridge Construction.

D 1883 CBR (California Bearing Ratio) of Laboratory-Compacted Soils.

D 2487 Classification of Soils for Engineering Purposes.

D 2844 Resistance R-Value and Expansion Pressure of Compacted Soils.

D 3282 Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes.

D 3740 Evaluation of Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.

F 1647 Organic Matter Content of Putting Green and Sports Turf Root Zone Mixes.

1.3 **SUBMITTALS**

A. **General**. If a change in source of material is required, submit name of Supplier, source and gradation analysis of material before delivery to site.

B. **Topsoil**. Submit certification from topsoil Supplier assuring topsoil product meets requirements in this Section.

C. **Borrow, granular borrow, granular backfill borrow, recycled fill, sand, gravel.** Before delivering material to site, identify:

1. Name of Supplier and source.
2. Gradation, classification and CBR.
3. Percent composition of reclaimed asphalt or concrete included in the mix.

D. **Slag, pumice, scoria**. Identify name of supplier, source, and density.

1.4 **QUALITY ASSURANCE**

A. Use a laboratory that complies with ASTM D 3740 and Section 01 45 00 requirements.

B. Reject fill products that do not meet requirements of this section.

C. Remove product found defective after installation and install acceptable product at no additional cost to OWNER.

1.5 **ACCEPTANCE**

A. General:

1. Acceptance is by Lot. One (1) lot is one (1) day productionl

2. Dispute resolution, Section 01 35 10.

B. Roadway Backfill: Sub-lot size is 5,000 tons.

PART 2 PRODUCTS

2.1 **BORROW**

A. Classifications A-1-a through A-4, ASTM D 3282.

2.2 **GRANULAR BORROW**

A. Classifications A-1-a, A-1-b, A-2-4, or A-3, ASTM D 3282.

B. Material meets design CBR-value (ASTM D 1883) or R value (ASTM D 2844) for suitability of source, not for project control testing.

2.3 **GRANULAR BACKFILL BORROW**

A. Classification A-1, ASTM D 3282.

B. Well graded.

C. Particle size, two (2) inch maximum.

D. Material meets design CBR-value (ASTM D 1883) or R value (ASTM D 2844) for suitability of source, not for project control testing.

2.4 **RECYCLED FILL**

A. Material: Pulverized portland cement concrete, pulverized asphalt pavement or combination, either mixed with or not mixed with a new aggregate.

B. Gradation: Meet requirements of this section based upon use; e.g. borrow, granular borrow, granular backfill borrow, etc.

2.5 **NATIVE**

A. When allowed by ENGINEER, material obtained from Excavations may be used as fill, provided organic material, rubbish, debris, and other objectionable materials are removed and CONTRACTOR has submitted the appropriate proctor density data (see Section 31 23 26).

2.6 **CLAY**

A. Classification CL, CL-ML, or ML, ASTM D 2487.

B. Free of organic matter, frozen material, debris, rocks, and deleterious

materials.

C. Homogeneous, relatively uniform.

2.7 **SAND**

A. Friable river or bank aggregate, free of loam and organic matter. Graded as follows.

Sieve	**Percent Passing by Weight**
3/8	100
100	1 – 10

2.8 **GRAVEL**

A. Material: Rock, stone, or other high quality mineral particle or combination.

Sewer Rock.

Nominal Size	ASTM Size No.
3.5 to 1.5”	1
2.5 to 1.5”	2
2 to 1”	3
1.5 to 3/4”	4
1 to 1/2"	5

Pea Gravel.

Nominal Size	ASTM Size No.
3/4 to 3/8”	6
1/2 to No. 4	7
3/8 to No. 8	8
No. 4 to No. 16	9
No. 4 (screenings)	10

2.9 **TOPSOIL**

A. Chemical Characteristics:

1. Acidity and alkalinity range: pH 5.5 to 7.7
2. Soluble Salts: Less than 2.0 mmhos/cm.
3. Sodium Absorption Ratio (SAR): less than 3.0
4. Nitrogen (NO_3N): 48 ppm minimum
5. Phosphorus (P): 11 ppm minimum
6. Potash (K): 130 ppm minimum
7. Iron (Fe): 5.0 ppm minimum

B. Physical Characteristics:

1. Fertile, loose, friable.
2. Free of weeds, subsoil, lumps or clods of hard earth, plants or their roots, sticks, toxic minerals, chemicals and stones greater than 1-1/2 inch diameter.

3. Composition, ASTM D 2487:

Material	Percent
Sand	15 – 60
Silt	10 – 70
Clay	5 – 30
Organic matter	2 - 5

Humus determined by ASTM F 1647. Peat may be used as an organic amendment to meet the humus requirements.

2.10 **SLAG, PUMICE, SCORIA**

A. Chemically inert, porous, durable, free draining.

Table 1 – Gradation and Density				
Criteria		**Slag**	**Pumice**	**Scoria**
Gradation, US Sieve	3”	100	100	100
	1 1/2"	80 – 100	80 – 100	80 – 100
	3/4"	20 – 100	--	--
	3/8”	0 – 20	0 – 20	40 – 100
	No. 4	0 – 10	0 – 10	10 – 70
	No. 16	--	0 – 65	0 – 40
	No. 50	--	0 – 40	0 – 25
	No. 200	0 – 3	0 – 3	0 – 15
Density, pound per cubic foot		85 – 100	75 – 80	60 – 75
NOTES: (a) Gradations are based upon percent of material passing sieve by weight, ASTM C 136. (b) Density measured as in-place target.				

2.11 **SOURCE QUALITY CONTROL**

A. Verify gradation, ASTM C 136.

B. Select samples on a random location and time basis.

C. If tests indicate materials do not meet specified requirements, change materials and retest at no additional cost to OWNER.

PART 3 EXECUTION Not Used

END OF SECTION

SECTION 31 11 00
SITE CLEARING

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Removal of trees, stumps, roots, and tree debris.

B. Clearing site of plant life, root systems and shrubs.

C. Removal of fences, fence posts, mail box posts, and miscellany.

1.2 **REFERENCES**

A. **NAA Standards**:

Pruning Standards for Shade Trees.

B. **Utah Shade Tree Pruning Standards**.

1.3 **QUALITY ASSURANCE**

A. Provide at least one person, who is familiar with NAA pruning standards for the type of tree involved, to be present during tree pruning operations.

1.4 **SITE CONDITIONS**

A. Repair or replace damaged trees and shrubs at no additional cost to OWNER.

1.5 **PROTECTION**

A. Protect roots and branches of trees to remain.

B. Construct temporary barricading at tree's approximated drip line. Place continuous barricades at least three (3) feet high.

C. When setting posts, avoid damaging tree roots.

D. Do not permit heavy equipment or stockpiling of materials or debris within the barricaded area, or permit earth surface to be changed.

E. Provide water and fertilizer to maintain existing trees.

PART 2 PRODUCTS

2.1 **STUMP TREATMENT SOLUTION**

A. Formulated to kill existing vegetation.

PART 3 EXECUTION

3.1 EXAMINATION

A. The drawings do not purport to show all trees and shrubs existing on site.

B. Verify with ENGINEER which plantings are to be removed or to remain.

C. Tree root inspection:

1. Assist ENGINEER by removing and replacing existing surface improvements.
2. Cost of removals and replacements will be paid for using existing payment prices, or if none, then by using contract Modification prices.

3.2 PREPARATION

A. Locate utilities. Preserve utilities that are to remain in service, Section 31 23 16.

B. Review work procedures with ENGINEER.

C. Schedule work carefully with consideration for property owners and general public.

D. Before starting, arrange for disconnection of all utility services that are to be removed or which interfere with work.

3.3 SITE CLEARING

A. Remove all vegetation outside of excavation, fill slope lines, and limits of slope rounding.

B. Remove fences, posts, appurtenances, and miscellaneous objects.

3.4 TREE REMOVAL

A. Remove branches, limbs, and debris.

B. Remove stumps and roots to 18 inches below proposed grade.

C. For stumps larger than six (6) inches caliper remove and treat as follows:

1. Remove chips and debris from around remaining stump.
2. Apply stump treatment solution in accordance with manufacturer's recommendations.
3. Do not allow chemical solution to mist, drip, drift, or splash onto adjacent ground surfaces or desirable vegetation.
4. Replace any existing vegetation damaged or killed through improper use of chemical at no additional cost to OWNER.

END OF SECTION

SECTION 31 23 16
EXCAVATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Excavation and disposal of excavated materials.

B. Protection of existing facilities such as utilities, vegetation, structures affected by excavation, etc.

1.2 PAYMENT PROCEDURES

A. No Contract Time extension shall be granted and no additional compensation shall be made if buried utilities or structures that conflict with the Work have not been found by Keyholing.

B. Perform Incidental Excavation at no additional cost to OWNER.

1.3 DEFINITIONS

A. **Authorized Over Excavation**: Upper limit of excavation is proposed excavation limit. Lower and lateral limits are as authorized by ENGINEER.

B. **Classified Excavation**: The excavation of specified materials.

C. **Incidental Excavation**: Excavation done for CONTRACTOR's benefit, excavation error, dewatering of excavation, slough, or over-break.

D. **Unclassified Excavation**: The excavation of all materials encountered regardless of the nature, size, or manner in which they are removed. Presence of isolated boulders or rock fragments will not be sufficient cause to change classification of surrounding materials.

E. **Keyholing**: The process of making a small, precisely controlled hole for “day-lighting”, or uncovering and exposing underground utilities, in order to locate or inspect them.

1.4 STORAGE AND HANDLING

A. Stockpile excavated material to cause minimum inconvenience to public and provide for emergency services as necessary.

B. Provide free access to existing fire hydrants, water valves, gas valves, and meters.

C. Provide free flow of storm water in all gutters, conduits, and natural water courses.

D. Utilize traffic control signs, markers, and procedures in product storage and handling activities.

E. Promptly remove other material from site.

PART 2 PRODUCTS

2.1 BACKFILL MATERIALS

A. Common fill, Section 31 05 13.

B. Aggregate base course, Section 32 11 23.

C. Stabilization fill, aggregate base course or common fill with maximum rectilinear particle size of two (2) inches.

D. Stabilization fabric, Section 31 05 19.

PART 3 EXECUTION

3.1 PREPARATION

A. Photograph existing surfaces where work will take place to document conditions before excavation, Section 01 78 39.

B. Use white paint and mark the proposed excavation.

C. Call the one-call center and wait the required amount of time. Colors of one call center marks indicate the following:

White	Proposed excavation
Red	Electric power lines, cables, conduit and lighting cables
Yellow	Gas, oil, steam, petroleum or gaseous materials.
Orange	Communications, alarm, signal, cables or conduits.
Blue	Potable water.
Purple	Reclaimed water, irrigation and slurry lines.
Green	Sewer and storm drain lines.
Pink	Temporary survey markings.

D. Implement the traffic control plan requirements, Section 01 55 26.

E. For temporary controls, refer to Section 01 57 00.

3.2 PROTECTION

A. Identify required lines, grades, contours, and benchmarks, Section 01 71 23.

B. Utilities:

1. Keyhole, expose or otherwise locate utilities as necessary to give utility agency at least one (1) day notice to protect, preserve, or relocate a utility that may interfere with or may be damaged by excavation work. Perserve utilities that remain in service.

2. Where utilities or structures conflict with design grades, report conflict to appropriate utility company and ENGINEER 14 days

before initiating work within the conflict area.

C. Support and protect from damage any existing facility and structure that exists in, passes through, or passes under the site.

D. Protect existing landscape sprinkler systems. When sprinkler system disturbance is required, interrupt and repair system so operation of system is maintained, Section 02 41 13.

E. Carefully remove soil around tree roots so ENGINEER can assess stability and health of tree.

3.3 **GENERAL EXCAVATION REQUIREMENTS**

A. Excavate topsoil from areas to be relandscaped or regraded and other marked areas.

B. Excavate site to line and grade indicated. Legally dispose of excavated material.

C. Carefully excavate soils in vicinity of buried utility marks placed by the one-call center.

D. Where soil has been softened or eroded by flooding or hardened by drying, rework all damaged areas or replace with approved material at no additional cost to OWNER.

E. Notify ENGINEER of unexpected subsurface conditions.

F. Underpin adjacent structure, service utilities and pipe chases that may be damaged by excavation work.

G. Protect excavation walls as required. If conditions permit, slope excavation sides to maintain a safe and clean working area. Remove loose materials.

H. Where ENGINEER deems subgrade material to be susceptible to frost heave or otherwise unsatisfactory, excavate additional depth.

3.4 **TOPSOIL**

A. Excavate topsoil only to depth that will preserve topsoil quality.

B. Do not mix topsoil with subsoil during stockpiling or spreading.

3.5 **SHORING**

A. Slope, shore, sheet, brace or otherwise support excavations over four (4) feet deep, Section 31 41 00.

B. When soil conditions are unstable, excavations shallower than four (4) feet deep must also be sloped, supported or shored.

3.6 **DEWATERING**

A. Keep excavation free from surface and ground water.

B. If ground water is in the intended construction operations, dewater excavations.

C. If there are no olfactory or visual indications of contamination in the water, discharge according to requirements of Federal, State or local agency having jurisdiction.

D. If any evidence of contamination in the water, based on olfactory or visual indications, cease excavation work until potential risks are

evaluated. During evaluation, handle water as a contaminated material.

E. Pay for damages and costs resulting from dewatering operations.

3.7 **ROADWAY EXCAVATION**

A. In advance of setting line and grade stakes, clear and grub area of brush, weeds, vegetation, grass, and debris. Drain all depressions or ruts.

B. Roadway excavation is Unclassified Excavation. It includes concrete or asphalt pavement removal and removal of any aggregate base or sub-base material to line and grade established by Drawings or ENGINEER.

3.8 **STRUCTURAL AND LANDSCAPE EXCAVATION**

A. Provide shoring, cribs, cofferdams, caissons, pumping, bailing, draining, sheathing, bracing, and related items.

B. For piling work, coordinate special requirements for piling. Protect excavation walls.

C. If conditions permit, slope excavation sides as excavation progress. Maintain a safe and clean working area.

D. Support excavations. Do not interfere with the bearing of adjacent foundations, pipelines, etc.

3.9 **TRENCH EXCAVATION**

A. Grade bottom of trenches to provide uniform bearing surface.

B. If necessary, make bell holes and depressions required for laying and joining pipe or box.

C. Limit width of trench excavations to the dimensions suitable for worker access per pipe manufacturer's recommendation. Provide enough space for compaction equipment. Notify ENGINEER if excavation operations exceed any indicated line and grade limits.

D. In roadways and regardless of trench depth, limit length of open trenches to 200 lineal feet day or night. Provide barricading, Section 01 55 26. Protect trenches over night.

3.10 **STABILIZATION EXCAVATION**

A. Perform stabilization excavation as Incidental Excavation.

3.11 **AUTHORIZED OVER EXCAVATION**

A. Over excavation must be permited by ENGINEER to be classified as authorized over excavation. Volume will be determined by the method of average-end-areas in the original position.

3.12 **TOLERANCE**

A. Grading: Top surface of Subgrade = plus or minus 1 inch.

END OF SECTION

SECTION 31 23 17
ROCK REMOVAL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Requirements for Rock removal and use of explosives to assist in Rock removal.

1.2 REFERENCES

A. **NFPA Standards**:

495 Manufacture, Transportation, Storage, and Use of Explosive Materials.

1.3 DEFINITIONS

A. **Rock**: Solid mineral material that cannot be removed with equipment reasonably expected to be used in the Work without cutting, drilling or blasting.

1.4 SUBMITTALS

A. Submit proposed method of blasting, delay pattern, explosive types, type of blasting mat cover, and intended Rock recovery method.

B. Submit photographs of existing site conditions and facilities in vicinity of Work before blasting. Refer to construction photographic requirements, Section 01 78 39.

1.5 QUALITY ASSURANCE

A. Seismic Survey Firm: Company specializing in seismic surveys with two (2) years documented experience.

B. Explosive Firm: Company specializing in explosives for disintegration of Rock with 2 years documented experience.

PART 2 PRODUCTS

2.1 EXPLOSIVES

A. Type recommended by explosives firm following seismic survey and required by authorities having jurisdiction.

2.2 DELAY DEVICES

A. Type recommended by explosives firm.

2.3 BLASTING MAT MATERIALS

A. Type recommended by explosives firm.

PART 3 EXECUTION

3.1 PREPARATION

A. Verify site conditions and note irregularities affecting work of this Section.

B. Obtain permits from authorities having jurisdiction before explosives are brought to site or drilling is started.

C. Locate and preserve utilities, Section 31 23 16.

D. Beginning work of this Section constitutes acceptance of existing conditions.

E. Comply with NFPA 495.

3.2 STORAGE OF BLASTING MATERIALS

A. Securely store all explosives in compliance with Laws and Regulations.

B. Mark all storage places clearly.

C. Where no local Laws or Regulations apply, provide storage not closer than 1,000 feet from any road, building, camping area or place of human occupancy.

3.3 ROCK REMOVAL - NONEXPLOSIVE METHOD

A. Cut away Rock at excavation bottom to form level bearing.

B. Remove shaled layers to provide sound and unshattered base for foundations.

C. Remove and legally dispose of excess excavated material and debris off-site unless indicated otherwise.

D. Correct unauthorized Rock removal at no additional cost to OWNER.

3.4 ROCK REMOVAL - EXPLOSIVE METHOD

A. Provide a qualified explosives expert to act as an advisor and consultant during drilling and blasting operations.

B. Advise owners of adjacent buildings or structures and utility companies in writing before setting up seismographs. Describe blasting and seismic operations.

C. Obtain and pay for a seismic survey before Rock excavation to determine maximum charges that can be used at different locations in area of excavation without damaging adjacent properties and utilities.

D. Provide seismograph monitoring during progress of blasting operations.

E. Disintegrate and remove Rock from excavation operations.

END OF SECTION

SECTION 31 23 26
COMPACTION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Compaction of granular fill materials.

1.2 REFERENCES

A. **ASTM Standards**:

D 698 Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3)).

D 1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3))

D 2216 Laboratory Determination of Water (Moisture) Content of Soil and Rock.

D 2922 Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

D 3017 Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

D 3282 Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes.

D 3740 Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.

1.3 DEFINITIONS

A. **A-1 Soil**: Defined in ASTM D 3282.

B. **Modified Proctor Density**: The maximum laboratory density, as defined in and determined by ASTM D 1557 using procedure A, B or C as applicable.

C. **Relative Density (or Relative Compaction):** The ratio of field dry density to the maximum laboratory density expressed as a percentage.

D. **Standard Proctor Density**: The maximum laboratory density, as defined in and determined by ASTM D 698 using procedure A, B or C as applicable.

1.4 QUALITY ASSURANCE

A. Use a soil and rock laboratory that complies with ASTM D 3740.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION

3.1 COMPACTION

A. Moisten or dewater backfill material to obtain optimum moisture for compaction.

B. When no density compactive effort is specified, compact the entire area to 95 percent and eliminate unstable zones.

C. Correct deficient compaction conditions. Replace or repair materials and damaged facilities.

3.2 FIELD QUALITY CONTROL

A. Testing: Perform control testing of materials. Perform additional testing at no additional cost to OWNER, for

1. Changes in source of materials or proportions requested by CONTRACTOR, or
2. Failure of materials to meet specification requirements, or
3. Other testing services needed or required by CONTRACTOR.

B. Optimum Soil Density: Use ASTM D 2216 and the following industry standards.

1. For A-1 Soils: Method C of ASTM D 1557 (Modified Proctor)
2. For All Other Soils: Method C of ASTM D 698 (Standard Proctor).

C. Field Density:

1. Use ASTM D 3017 and test method C of ASTM D 2922 for shallow depth nuclear testing.
2. No density determinations are required on any material containing more than 65 percent material retained on the number 10 sieve or more than 60 percent material retained on the number 4 sieve. In lieu of reporting densities in such cases, report the sieve analysis to document the material type.

3.3 REPORT

A. For each material tested, document the following:

1. Vertical and horizontal location of the test.
2. Optimum laboratory moisture content.
3. Field moisture content.
4. Maximum laboratory dry density.
5. Field density.
6. Percent compaction results.
7. Certification of test results by Independent Testing Agency.

END OF SECTION

SECTION 31 25 00
EROSION AND SEDIMENTATION CONTROL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Erosion control and slope protection facilities including blankets or mulches.

B. Construction of drainage facilities to protect work area.

1.2 SUBMITTALS

A. Submit before using:

1. Sample of blanket or geotextile materials.
2. Mulch formula.
3. Grass mixture listing.
4. Plant list.
5. Geotextile manufacturer's certification.

B. Application rate of fiber mulches recommended by tackifier manufacturer.

1.3 DELIVERY, STORAGE AND HANDLING

A. Deliver seed in original containers with certified germination test results showing analysis of seed mixture, percentage of pure seed, year of production, and date of packaging. Damaged packages are not acceptable. Store seed free of moisture.

B. Deliver fertilizer in waterproof bags showing weight, chemical composition and name of manufacturer.

C. Deliver blanket in original wrapping showing name of manufacturer and product weight.

D. Deliver plant materials immediately before placement.

E. Replace plant when original root protection system (burlap bag wrap of earth ball, plastic container with special plant bedder, etc.) has been broken or displaced before planting.

PART 2 PRODUCTS

2.1 MATERIALS

A. Riprap: Rock, Section 31 37 00.

B. Blankets: Uniform open weave jute, wood fiber, biodegradable or photodegradable synthetic fiber matting.

C. Geotextiles: Section 31 05 19.

D. Erosion Control Vegetation Mats: Permanent three dimensional mats that allow for revegetation where high water flows are expected.

E. Fiber Mulches: Straw, hay, wood or paper free from weeds and foreign matter detrimental to plant life.

F. Mulch Binder: Vegetable based gel tackifier with growth stimulant.

G. Topsoil and Fertilizer: Section 31 05 13 and Section 32 92 00.

PART 3 EXECUTION

3.1 PREPARATION

A. Remove foreign materials, roots, rocks, debris.

B. Grade to eliminate rough spots, ponding areas.

C. Grade soil to drain perimeter water away from protected areas.

D. Temporary controls, Section 01 57 00 as applicable.

3.2 SLOPE PROTECTION BLANKET

A. Cover seeded slopes where grade is greater than one (1) vertical to three (3) horizontal with blanket. Roll down over slopes carefully and loosely without stretching or pulling.

B. Lay blanket smoothly on prepared soil surface. Bury top end of each section in a narrow trench. Leave 24 inches overlap from top roll over bottom roll. Leave 12 inches overlap over adjacent section.

C. Toe-wrap fabric at bottom of slope.

D. Staple loosely the outside edges and overlaps.

E. In ditches, lay matting in upstream direction. Overlap and staple ends six (6) inches with upstream section on top.

F. If natural drainage water traverses protected or controlled area; construct a channel or riprap Section 31 37 00.

G. Lightly dress slopes with topsoil to ensure close contact between cover and soil.

H. Present alternative methods of protection for approval before starting any work.

3.3 GEOTEXTILE

A. Placement, Section 31 05 19.

3.4 MULCHES

A. Apply mulches at the rate necessary.

B. When installed with a tackifier, apply at the rate recommended by the tackifier supplier.

3.5 SURFACE COVER

A. Grass, Section 32 92 00.

B. Ground cover, Section 32 93 13.

3.6 MAINTENANCE

A. Maintain surfaces and supply additional topsoil where necessary, including areas affected by erosion.

B. Protect and repair geotextiles, Section 31 05 19.

C. Keep surface of soil damp only as necessary for seed germination.

D. Apply water slowly so surface of soil will not puddle and crust.

E. Replant damaged grass areas showing root growth failure, deterioration, bare or thin spots, and eroded areas.

F. Re-fertilize 60 days after planting.

G. Remove weeds that are over three (3) inches high.

END OF SECTION

SECTION 31 31 19
VEGETATION CONTROL

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Application of soil treatment to remove weed and vegetation.

1.2 **SUBMITTALS**

A. Submit certificate identifying composition of non-selective control herbicide.

PART 2 PRODUCTS

2.1 **HERBICIDE**

A. Water soluble herbicide for non-selective control of annual and perennial weeds.

PART 3 EXECUTION

3.1 **MIXING**

A. Mix herbicide solution in strict accordance with manufacturer's instructions and applicable Laws and Regulations.

3.2 **APPLICATION**

A. Execute all work in an orderly and careful manner with due consideration for surrounding plantings that are to remain.

B. Apply herbicide solution with a shield applicator. Do not allow solution to mist, drip, drift, or splash onto desirable vegetation.

C. Apply solution according to manufacturer's recommendations seven (7) days before preparation of surface to receive additional cover material. Do not add cover material until ENGINEER reviews spraying results.

D. Do not spray under windy or adverse weather conditions.

E. Replace portions of surrounding vegetation damaged or killed through this operation.

END OF SECTION

SECTION 31 37 00
RIPRAP OR ROCK LINING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Placement of loose riprap, hand-placed riprap, or grouted riprap.

1.2 REFERENCES

A. **ASTM Standards**:

C 535 Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

1.3 SUBMITTALS

A. Submit before use in the Work product data showing riprap source, gradation, aggregate wear and placement technique.

PART 2 PRODUCTS

2.1 AGGREGATE

A. Durable, angular, hard stone free from seams and cracks.

B. Graded in size to produce a reasonably dense mass.

C. The greatest dimension of 25 percent of the stones shall be at least, equal to but not more than 1-1/2 times the thickness of riprap indicated.

D. The greatest dimension of 50 percent of the stone shall be at least 3/4, but not more than 1-1/2 times the thickness of riprap indicated.

E. Not more than 10 percent of the aggregate shall have a dimension less than 0.1 times the thickness of riprap.

F. At least 95 percent of the stones shall have at least two (2) fractured or clean angular faces.

2.2 ACCESSORIES

A. Portland cement grout, Section 03 61 00.

B. Geotextile fabric, Section 31 05 19.

C. Grout, Section 04 05 16.

2.3 SOURCE QUALITY CONTROL

A. Aggregate: Wear not greater than 40 percent when tested, ASTM C 535.

PART 3 EXECUTION

3.1 PREPARATION

A. Remove all brush, trees, stumps, and other objectionable materials and dress area to a smooth surface. Make Excavation to provide a firm foundation and protect against undercutting. Secure approval before backfilling.

B. Install required geotextile in accordance with Section 31 05 19.

3.2 LOOSE-PLACED RIPRAP

A. Place stones to secure a Rock mass with the minimum thickness and height indicated. Manipulate Rock to secure a regular surface of graded size and mass stability.

3.3 HAND-PLACED RIPRAP

A. Place and bed rocks, one against the other, and key together. Fill irregularities between stones with suitable size spalls.

B. Place so finished surface of riprap is even, tight, and true to line and grade. Extend riprap sufficiently below ground surface to secure a firm foundation.

3.4 GROUTED RIPRAP

A. After placement and wetting the stones, sweep sand or fine gravel into the interstices to fill to within four (4) inches of the outer surface of the riprap.

C. Fill the remaining volume of the interstices flush with a well-mixed grout.

D. Keep grout wet by sprinkling or covering with wet material for at least three (3) days. Protect grout from stream water or any other disturbance during this cure period.

E. Do not place grout in freezing weather.

END OF SECTION

DIVISION 32

EXTERIOR IMPROVEMENTS

SECTION 32 01 05
INFORMATION, REGULATORY, AND WARNING SIGNS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Information, regulatory, and warning signs but not street name signs or construction signs.

1.2 REFERENCES

A. **ASTM Standards**:

1. ASTM B 209: Standard Specification for Aluminum and Aluminum - Alloy Sheet and Plate.

B. Federal Specification (General Services Administration).

1. FS L-P 380: Plastic Molding Material Methacrylate.
2. FS L-S-300: Sheeting and Tape, Reflective: Nonexposed Lens.

C. National Bureau of Standards:

1. PS 1: Construction and Industrial Plywood.

D. MUTCD: Manual on Uniform Traffic Control Devices for Streets and Highways.

1.3 DEFINITIONS

A. For definition purposes, the various types of signs are identified by a combination of letter and number. The letter represents the type of sign panel construction and the number represents the type of lettering and symbols to be used as follows:

1. Panel Type:
   a. Type A: Reflectorized sheeting on sheet aluminum.
   b. Type B: Reflectorized sheeting on plywood.
2. Letter Type:
   a. Type 1: Reflectorized demountable cutout letters, symbols, and borders with prismatic reflectors.
   b. Type 2: Opaque legend and borders.
   c. Type 3: Reflectorized permanently attached cutout letters, symbols, and borders or reflectorized screen processed letters, symbols, and borders.

1.4 SUBMITTALS

A. Submit Shop Drawings of support structures before fabrication.

B. Submit sample of each color of reflective sheeting including manufacturer's name and product number.

PART 2 PRODUCTS

2.1 MATERIALS

A. Sign Blank:

1. Aluminum Sheet: 0.1 inch thick ASTM B 209 alloy 6061-T6.
2. Aluminum Extrusion: 0.1 inch thick ASTM B 209 alloy 6063-T5 and 6063-T6.
3. Softwood Plywood: PS 1 Group 1 with each panel bearing initials DFPA Grade - Trademark of the American Plywood Association; painted to ENGINEER's choice of color unless indicated.

B. Posts: Galvanized structural steel, U-shaped, T-shaped, C-shaped, box-shaped, or round tube, Section 05 12 00, with 3/8 inch diameter mounting holes.

C. Fabricated Supports: Galvanized steel, Sections 05 05 10 and 05 12 00.

D. Sheeting:

1. Reflective: FS L-S-300 with 2,200 hours minimum durability.
2. Nonreflective: Nonchalking, weather resistant transparent plastic having a protected adhesive backing and a smooth flat outer surface with glass spheres embedded within.

E. Prismatic Reflectors: Methyl methacrylate lens meeting FS L-P-380 requirements with aluminum frame.

F. Bolts, Nuts, Accessories: Galvanized steel, Section 05 05 23.

G. Cast-in-place Concrete: Class 3000 minimum, Section 03 30 04.

2.2 COLORS AND FORMAT

A. Sign Colors and Format: MUTCD.

B. Provided colors of same reflectorized hue in daylight and night under artificial white illumination.

PART 3 EXECUTION

3.1 PREPARATION

A. Locate and preserve utilities, Section 31 23 16.

B. Excavation, Section 31 23 16.

3.2 INSTALLATION

A. Do not remove a sign that is being replaced until the new sign is placed and uncovered. Provide temporary covering. Maintain covering until removal.

B. Unless indicated otherwise use clearance and locations shown in MUTCD. Install posts plumb and in proper alignment. Construct sign

post foundations with concrete. Finish foundations flush with or below natural ground.

C. Establish proper elevation and orientation of all signs, structures, and determine proper sign post lengths as dictated by construction slopes.

D. Construct overhead support structures where indicated with signs horizontal and perpendicular to roadway. Minimum allowable vertical clearance from high point of pavement is 16.5 feet.

3.3 **WORKMANSHIP**

A. Carefully fabricate and erect signs. Damage signs will be rejected.

B. Make all vertical joints and cuts flat and true.

C. Elevator bolts may be used or bolt holes relocated where conflict exists with sign border, legend, or copy.

D. Lay out and properly balance on the sign face all Type 1 legend and copy before fastening. Plug holes left by shifting of copy or legend with the same type screw used to fasten the legend.

E. Wash all sign faces before final inspection, Section 01 74 13.

END OF SECTION

SECTION 32 01 10
RELOCATE FENCES AND GATES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Reset existing fences and gates in new locations.

PART 2 PRODUCTS

2.1 MATERIALS

A. Nails, Spikes and Staples: Galvanized steel for exterior, high humidity locations, and treated wood. Size and type to suit applications.

B. Chain Link Fences and Gates: Section 32 31 13.

C. Wire Fences and Gates: Section 32 31 16.

D. Concrete: Class 3000 minimum, Section 03 30 04.

PART 3 EXECUTION

3.1 PREPARATION

A. Coordinate locating utilities, Section 01 31 13.

B. Excavation, Section 31 23 16.

3.2 INSTALLATION

A. Completely remove all existing posts, footings, wires, gates, and other items used in fencing.

B. Remove concrete on posts. Reuse posts, wire, and gates from existing fence.

C. Replace any fencing materials and gates that are damaged, lost, or broken during fence and gate relocations. Provide new materials as required which meets Specifications, for fence and gates of the same type.

D. Set relocated fences and gates straight and true.

E. Fill in old post holes unless they become part of new construction.

F. Reset posts in concrete, eight (8) inches in diameter to depth indicated or two (2) feet minimum.

END OF SECTION

SECTION 32 05 10
BACKFILLING ROADWAYS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Roadway backfill materials.

B. Roadway backfilling requirements.

1.2 REFERENCES

A. **APWA (Utah Chapter) Standards**:

Plan 245 Roadway Stabilization.

B. **ASTM Standards**:

D 698 Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3)).

D 1557 Laboratory Compaction Characteristics of Soil using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3)).

D 2922 Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

D 4832 Preparation and Testing of Soil-Cement Slurry Test Cylinders.

1.3 DEFINITIONS

A. **Embankment**: A raised earthen structure.

B. **Pavement**: A surface or covering, as of concrete, asphal concrete, brick, concrete paver, etc., specifically a paved street, sidewalk, curb, gutter, curb cut assembly, ramp, apron, Driveway, etc.

C. **Subgrade**: A surface of native earth or Rock leveled off as to receive backfill materials.

1.4 SUBMITTALS

A. Submit maximum laboratory dry density and optimum laboratory moisture content for:

1. Subgrade material.
2. Each type of fill to be used.

B. Submit aggregate batch delivery tickets showing name of material source, serial number of ticket, date and truck number, name of Supplier, job name and location, volume or weight, and aggregate classification or Supplier's identification code.

1.5 QUALITY ASSURANCE

A. Do not change material sources, or aggregate without ENGINEER's knowledge.

B. Reject backfill material that does not comply with requirements specified in this section.

C. If requested, submit a quality control Inspection and testing report describing source and field quality control activities performed by CONTRACTOR and Suppliers.

1.6 STORAGE

A. Safely stockpile backfill materials.

B. Separate differing materials, prevent mixing, and maintain optimum moisture content of backfill materials.

1.7 SITE CONDITIONS

A. Do not place, spread, or roll any backfill material over material that is damaged by water. Remove and replace damaged material at no additional cost to OWNER.

B. Control traffic and erosion. Keep area free of trash and debris. Repair settled, eroded, and rutted areas.

C. Reshape and compact damaged structural roadway section to required density.

D. Soil Cement: Do not spread soil cement mixture when air temperature is less than 40 deg F in the shade.

E. Drainage: Immediately before suspension of construction operations for any reason, provide proper and necessary drainage of work area.

1.8 ACCEPTANCE

A. General: Native material may be wasted if there is no additional cost to substitute material acceptable to ENGINEER.

B. Material: For material acceptance refer to:

1. Common fill, Section 31 05 13.
2. Aggregate base course, Section 32 11 23.
3. Cement treated fill, Section 31 05 15.

C. Lift Thickness: One test per Lot.

D. Compaction: One test per Lot. Verify density using nuclear tests, ASTM D 2922. Compaction standard and Lot size as follows:

Table 1 – Compaction Standard and Lot Sizes		
Material	**Proctor**	**Lot Size**
Subgrade	Standard	1000 square yards
Common Fill	Standard	PCC or AC Surface Course: 1,000 square yards per lift Driveway Approach: 400 square feet per lift Sidewalk: 400 linear feet per lift
Aggregate base course	Modified	PCC or AC Surface Course: 1,000 square yards per lift Driveway Approach: 400 square feet per lift Sidewalk: 400 linear feet per lift Curb, Gutter, and Waterways: 200 linear feet per lift
NOTES (a) Standard proctor, ASTM D 698. (b) Modified proctor, ASTM D 1557.		

E. Flowable Fill Strength: Lot size is one day production with sub-lots of 250 cubic yards or part thereof. Verify strength using cylinders, ASTM D 4832.

F. Grade, Cross Slope: Measured at random locations.

1.9 **WARRANTY**

A. Repair incidental settlement or settlement damage at no additional cost to OWNER.

PART 2 PRODUCTS

2.1 **BACKFILL MATERIALS**

A. Common fill, Section 31 05 13: Granular material, CONTRACTOR's choice.

B. Aggregate base course, Section 32 11 23: Untreated base course.

C. Cement treated fill, Section 31 05 15: Use a flowable fill so vibration is not required.

2.2 **WATER**

A. Make arrangements for sources of water during construction and make arrangements for delivery of water to site.

B. Comply with local Laws and Regulations at no additional cost to OWNER when securing water from water utility company.

2.3 **GEOTEXTILE**

A. Stabilization separation fabric, Section 31 05 19: Woven, high MARV.

PART 3 EXECUTION

3.1 PREPARATION

A. Implement the traffic control plan requirements, Section 01 55 26.

B. Verify:

1. Backfill material meets gradation requirements.
2. Areas to be backfilled are free of debris, snow, ice or water.
3. Bearing surfaces are not frozen.

C. If ground water is in the intended backfill zone, dewater.

3.2 PROTECTION

A. Protect existing trees, shrubs, lawns, structures, fences, roads, sidewalks, paving, curb and gutter and other features.

B. Protect above or below grade utilities. Contact utility companies to repair utility damage. Pay all cost of repairs.

C. Avoid displacement of and damage to existing installations while compacting or operating equipment. Do not fill adjacent to structures until excavation is checked by ENGINEER.

D. Do not use compaction equipment adjacent to walls or retaining walls that may cause wall to become over-stressed or moved from alignment.

E. Do not disturb or damage foundation perimeter drainage, foundation, damp-proofing, foundation waterproofing and protective cover, or utilities in trenches. Movement of construction machinery over work at any stage of construction is solely at CONTRACTOR's risk.

F. Restore any damaged structure to its original strength and condition.

3.3 LAYOUT

A. Identify required line, levels, contours, and datum.

B. Stake and flag locations of underground utilities.

C. Upon discovery of unknown utility or concealed conditions, notify ENGINEER.

D. Maintain all benchmarks, control monuments and stakes, whether newly established by surveyor or previously existing. Protect from damage and dislocation.

E. If discrepancy is found between Contract Documents and site, ENGINEER shall make such minor adjustments in the Work as necessary to accomplish the intent of Contract Documents without increasing the Cost of the Work to CONTRACTOR or OWNER.

3.4 SUBGRADE

A. Protect Subgrade from desiccation, flooding, and freezing.

B. Before backfilling over Subgrade, get ENGINEER's review of Subgrade surface preparations.

C. If Subgrade is not readily compactable, get ENGINEER's permission to stabilize the Subgrade:

1. Excavation for Subgrade stabilization is incidental work. Section 31 23 16.

2. Place geotextile fabric, APWA Plan 245. Place acceptable fill in lifts over the geotextile, compact and wrap.

3.5 EMBANKMENTS

A. Place backfill material in lifts not exceeding equipment compaction capability.

B. Build shoulders to a grade higher than that of adjacent fills. Provide surface runoff at all times.

C. Commence compaction along edge of area to be compacted and gradually advance toward center.

D. Operate compaction equipment along lines parallel or concentric with the center-line of the embankment being constructed.

E. Do not damage subsurface structures or utilities.

3.6 BASE COURSES

A. Place backfill material in lifts not exceeding eight (8) inches before compaction.

B. Maintain moisture content in compaction operations.

C. Avoid segregation when spreading backfill. Keep surfaces free from pockets of coarse and fine aggregate.

D. Rework fills that do not conform to compaction requirements until requirements are met.

E. Protect cement treated fill against freezing and traffic for seven (7) days.

3.7 MODIFIED BACKFILL LAYER METHOD

A. Section 33 05 20.

3.8 TOLERANCES

A. Compaction: Ninety-five (95) percent or greater relative to a standard or modified proctor density, Section 31 23 26.

B. Lift Thickness (before compaction):

1. Eight (8) inches when using riding compaction equipment.

2. Six (6) inches when using handheld compaction equipment.

3. As proven in the modified backfill layer method, Section 33 05 20.

C. Cement Treated Fill: Compressive strength targets are 60 psi in 28 days. Maximum is 90 psi in 28 days.

3.9 FIELD QUALITY CONTROL

A. Test roadway backfilling until a compaction pattern acceptable to CONTRACTOR and ENGINEER is achieved. Continue random quality control compaction testing.

B. Proof Rolling Test:

1. Before placing fill material for roadbed backfills, proof roll subgrade using gross weight of 18,000 pounds/tandem axle, with a tire pressure at least 90 psi.
2. All proof roll passes will traverse the subgrade parallel to the roadbed centerline. All subsequent passes will be offset 1/2 the vehicle width until the entire subgrade is tested.
3. ENGINEER will analyze, determine, designate and measure the areas, if any, requiring additional compaction or reconstruction.
4. Once subgrade passes the proof rolling test, protect the surface from construction operations and traffic damage. Repair all cuts, ruts, and breaks. Keep surface in a satisfactory condition until geotextile fabric or base course has been placed.

3.10 CLEANING

A. Remove stockpiles from site when work is complete. Grade site to prevent free standing surface water.

B. Leave borrow areas clean and neat.

END OF SECTION

SECTION 32 11 23
AGGREGATE BASE COURSES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Treated and untreated base course production and placement.

1.2 REFERENCES

A. **AASHTO Standards**:

R 9 Acceptance Sampling Plans for Highway Construction.

B. **ASTM Standards**:

C 29 Unit Weight and Voids in Aggregate.

C 131 Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

C 117 Materials Finer Than 0.075mm (No. 200) Sieve in Mineral Agtgregates by Washing.

C 136 Sieve Analysis of Fine and Coarse Aggregates.

D 75 Sampling Aggregates.

D 448 Sizes of Aggregate for Road and Bridge Construction.

D 1557 Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3)).

D 1883 CBR (California Bearing Ratio) of Laboratory-Compacted Soils.

D 2216 Laboratory Determinations of Water (Moisture) Content of Soil and Rock.

D 2419 Sand Equivalent Value of Soils and Fine Aggregate.

D 2922 Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

D 3017 Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

D 3665 Random Sampling of Construction Materials.

D 3740 Evaluation of Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.

D 4318 Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

D 5821 Standard Test Method for Determining the Percentage of Fractured Particles in Coarse Aggregate.

1.3 DEFINITIONS

A. **Master Grading Band**: A graphical area defined by gradation limits allowed for various sieve sizes ranging from the maximum sieve size to the No. 200 sieve.

B. **Target Grading Curve**: A smooth locus of points within the limits of the Master Grading Band.

C. **Target Grading Band**: Gradation limits defined by the allowable variance from the Target Grading Curve. It is possible that these limits may lie outside of the Master Grading Band.

D. **Mean of Deviations**: The sum of the absolute values of the variance between each screen target value and each measured value divided by the number of tests in the Lot.

E. **RAP** (acronym for reclaimed asphalt pavement): See Section 32 12 16.18.

F. **Lot**: (a) Quantity of aggregate delivered to a site when considering gradation, (b) area of aggregate placed at a site when considering density.

1.4 SUBMITTALS

A. **Mix Design**: Provide the following. Allow ENGINEER 10 days to evaluate the submittal.

1. Date of mix design. If older than 365 days from date of submission, recertify mix design.
2. Name of supplier and aggregate source.
3. Target gradation for each sieve size,
4. Percent composition of reclaimed asphalt or concrete included in the mix.
5. Unit weight, CBR, relative density, and relative moisture content.
6. Aggregate physical properties (this section article 2.1). The information is for suitability of source and not for project control. A new report may be required if aggregate source is changed. Test results shall not be older than 455 days from date of submission.

B. **At Delivery**: Submit batch delivery ticket identifying serial number of ticket, date and truck number, job name, weight of aggregate, mix identification, and description.

1.5 QUALITY ASSURANCE

A. Do not change aggregate source until ENGINEER accepts new source and new mix design.

B. Use a laboratory that follows and complies with ASTM D 3740 and Section 01 45 00 requirements.

C. If requested, submit a quality control and testing report describing source and field quality assurance activities performed by CONTRACTOR and Suppliers.

1.6 ACCEPTANCE

A. General:

1. Acceptance is by lot.
2. If non-complying material has been installed and no price for the material is specified, apply pay adjustment against cost of work requiring complying material as part of its installation, Section 01 29 00.
3. ENGINEER is not obligated to accept changes in gradation target after any material is delivered to site.
4. Observation of CONTRACTOR's field quality control testing does not constitute acceptance. Such testing; however, may be used by ENGINEER for acceptance if requirements in Section 01 35 10 are met.
5. Dispute resolution, Section 01 35 10.

B. Gradation: Lot size is one (1) day production. Sub-lot size is 500 tons. Collect samples from grade before compaction. Conduct at least one (1) gradation analysis for each lot. Lot is acceptable if gradation test deviations are within pay factor 1.00 limits. At ENGINEER's discretion, a lot with a sub-lot deviation greater than pay factor 0.70 limits may stay in place at 50 percent pay.

Table 1- Gradation Pay Factors

Criteria	Pay Factor	Mean of Deviations of Acceptance Tests From the Target Grading Curve Expressed in Percentage Points				
		1 Sample	2 Samples	3 Sample	4 Sample	5 or More Samples
1/2" and Larger Sieves	1.00	0 – 15	0.0 – 12.1	0.0 – 10.8	0.0 – 10.0	0.0 – 9.5
	0.95	16 – 17	12.2 – 13.9	10.9 – 12.4	10.1 – 11.5	9.6 – 11.
	0.90	18 – 19	14.0 – 15.1	12.5 – 13.5	11.6 – 12.5	11.1 – 11.9
	0.80	20 – 21	15.2 – 17.2	13.6 – 15.3	12.6 – 14.2	12. – 13.5
	0.70	22 – 23	17.3 – 18.8	15.4 – 16.7	14.3 – 15.5	13.6 – 14.7
3/8" Sieve	1.00	0 – 15	0.0 – 11.5	0.0 – 9.8	0.0 – 8.8	0.0 – 8.0
	0.95	16 – 17	11.6 – 13.2	9.9 – 11.3	8.9 – 10.1	8.1 – 9.2
	0.90	18 – 19	13.3 – 14.4	11.4 – 12.3	10.2 – 11	9.3 – 10.0
	0.80	20 – 21	14.5 – 16.3	12.4 – 13.9	11.1 – 12.5	10.1 – 22.4
	0.70	22 – 23	16.4 – 17.9	14.0 – 15.2	12.6 – 13.6	11.5 – 12.4
No. 4 Sieve	1.00	0 – 14	0.0 – 10.5	0.0 – 8.8	0.0 – 7.8	0.0 – 7.0
	0.95	15 – 17	10.6 – 12.1	8.9 – 10.1	7.9 – 9.0	7.1 – 8.0
	0.90	18	12.2 – 13.1	10.2 – 11	9.1 – 9.8	8.1 – 8.7
	0.80	19 – 20	13.2 – 14.9	11.1 – 12.5	9.9 – 11.1	8.8 – 10.0
	0.70	21 – 22	15.0 – 16.3	12.6 – 13.6	11.2 – 12.1	10.1 – 10.8
No. 16 Sieve	1.00	0 – 11	0.0 – 8.2	0.0 – 6.9	0.0 – 6.2	0.0 – 5.6
	0.95	12 – 13	8.3 – 9.4	7.0 – 7.9	6.3 – 7.1	5.7 – 6.4
	0.90	14	9.5 – 10.3	8.0 – 8.6	7.2 – 7.8	6.5 – 7.0
	0.80	15 – 16	10.4 – 11.6	8.7 – 9.8	7.9 – 8.8	7.1 – 8.0
	0.70	17	11.7 – 12.7	9.9 - 10.7	8.9 – 9.6	8.1 – 8.7

No. 200 Sieve	1.00	0 – 4.5	0.0 – 3.4	0.0 – 2.9	0.0 – 2.5	0.0 – 2.3
	0.95	4.6 – 5.2	3.5 – 3.9	3.0 – 3.3	2.6 – 2.9	2.4 – 2.6
	0.90	5.3 – 5.6	4.0 – 4.3	3.4 – 3.6	3.0 – 3.1	2.7 – 2.9
	0.80	5.7 – 6.4	4.4 – 4.9	3.7 – 4.1	3.2 – 3.6	3.0 – 3.3
	0.70	6.5 – 7.0	4.9 – 5.3	4.2 – 4.5	3.7 – 3.9	3.5 – 3.6

NOTES
(a) ENGINEER has 36 hours after Lot placement to accept aggregate gradation. CONTRACTOR may place material over the crushed aggregate base material during the 36 hours interval at its own risk. Pay factors for the Lot will NOT be applicable if ENGINEER performs tests after the 36 hours interval.

C. Relative Density: Lot size 10,000 cubic yards. Conduct at least one laboratory determination to be used as a standard for field density and field moisture content determinations.

D. Field Density: Lot size is one (1) day placement. Number of density tests varies according to placement type, location and sub-lot size (Table 2). Conduct at least one (1) field density test in the lot. Select each test location randomly.

Table 2 – Placement Type, Location, Sub-lot Size

Type	Location	Sub-lot Size
I	Pavement (includes curb, gutter and water way when in conjunction with pavement placement).	1,000 square yards
II	Curb, gutter, waterway	200 linear feet
	Sidewalk	400 linear feet
	Driveway approach, curb cut assembly, waterway transition structure, flat work	400 square feet
III	Landscaping and other non-structural, non- load bearing areas	--

PART 2 PRODUCTS

2.1 UNTREATED BASE COURSE

A. Material: Crushed rock, gravel, sand, or other high quality mineral particle, or combination that is free of organic matter, free of chemical or petroleum contamination, and meets the following physical properties.

Table 3 – Untreated Base Course Physical Properties				
Properties	**ASTMs**	**Aggregate Class**		
		A	**B**	**C**
Coarse aggregate				
Angularity (2 fractured faces), min., percent	D 5821	50	–	–
Wear (toughness or hardness), max., percent	C 131	50		
Fine aggregate				
Liquid Limit, max.	D 4318	25		
Plastic Index, max.	D 4318	0	0	6
Sand Equivalent, min., percent	D 24 19	35		
Blended aggregate				
Dry Rodded Unit Weight, min., percent	C 29	75		
CBR, min., percent	D 1883	70	55	--

NOTES
(a) Faces: Retained on No. 4 sieve.
(b) Wear: Retained on No. 12 sieve after 500 revolutions.
(c) Liquid limit and plastic index: Passing No. 40 sieve.
(d) Sand equivalent (clay content or cleanliness): Passing No. 4 sieve.
(e) CBR: Use a surcharge of 10 pounds measured at 0.20 inch penetration at 95 percent relative to a modified proctor density. A reduction in aggregate class may be accepted providing any costs for difference in excavation, backfill, and alternate design for CBR does not increase Concrete Price.

B. Gradation: Analyzed according to ASTM C 136 on a dry weight and percent passing basis. Target Grading Curve must lie within the gradation limits of the selected Master Grading Band limits. Field gradation shall not vary from target by more than the target tolerance.

Table 4 – Target Gradation Limits				
Sieve	**Master Grading Bands**			**Tolerance**
	Grade 1-1/2	**Grade 1**	**Grade 3/4**	
1-1/2"	100	–	–	Pay factor 1.00 Table 1
1 "	–	100	–	
3/4 "	70 – 85	–	100	
1/2 "	–	79 – 91	–	
3/8 "	55 – 75	–	78 – 92	
No. 4	40 – 65	49 – 61	55 – 67	
No. 16	25 – 40	27 – 35	28 – 38	
No. 200	7 – 11	7 – 11	7 – 11	

NOTES
(a) It is assumed fine and course aggregate have same bulk specific gravity.
(b) Target tolerance for 3/4 sieve in Grade 3/4, and 1” sieve in Grade 1 is not applicable.
(c) Percentage of fines passing No. 200 sieve determined by washing, ASTM C 117.

C. Changing Source: A new material properties report is required.

2.2 TREATED BASE COURSE

A. Treatment includes addition of lime, cement slurry, asphalt emulsion, RAP, crushed concrete, or any combination, or other material acceptable to ENGINEER.

B. Base course containing RAP:

1. Meet requirements of this section article 2.1 and the following:

a. Sand equivalent and fractured face measured after asphalt residue is burned off.

b. Plasticity and wear requirements apply to virgin aggregate portion only.

c. Allowable asphalt content is controlled by allowable CBR.

2. Remove debris from crushed RAP aggregate by screening.

3. Mechanically blend virgin and RAP aggregates. Do not use windrows for blending.

C. Base course containing crushed concrete.

1. Meet requirements of this section article 2.1 and the following:

a. Cement with its chemical components is allowed.

b. Wear test and fractured face test not required.

2.3 SOURCE QUALITY CONTROL

A. Reject crushed aggregate base products that do not meet requirements of this Section.

B. Sampling Protocol: Random location selection, ASTM D 3665. Sample collection, ASTM D 75.

C. Testing Protocol: Gradation, ASTM C 136. Maximum density, ASTM D 1557. Optimum moisture content, ASTM D 2216.

PART 3 EXECUTION

3.1 SUB-BASE PREPARATION

A. Trenches, Section 33 05 20.

B. Structures, Section 31 23 23.

C. Landscaping, Section 32 91 19.

D. Pavements, Section 32 05 10.

3.2 PLACEMENT

A. General:

1. Place uniform lifts not exceeding eight (8) inches before compaction.

2. Maintain optimum moisture content plus or minus two (2) percent.

3. Use appropriate compaction equipment.

4. Do not place additional material on any unaccepted layer or on any

frozen surface.

B. Provide aggregate suitable for the following locations.

Table 5 – Placement Type, Location, and Aggregate Class				
Type	**Location**	**Aggregate Class**		
		A	**B**	**C**
I	Pavement (includes curb, gutter and waterway when in conjunction with pavement placement).	X		
II	Concrete flat work (includes driveway approach, curb cut assembly, curb, gutter, sidewalk, waterway, etc.	X	X	
III	Landscape (includes non-structural, non-load bearing areas.	X	X	X
NOTES: (a) X indicates where placement is allowed.				

C. Compaction:

1. Type I and Type II Placement: 95 percent minimum.
2. Type III Placement: Suitable to overlying surface, or installation, or use. Verify compactive effort with ENGINEER.

D. Finish: Uniform with surface deviation no more than 3/8 of an inch from line and grade in 10 feet in any direction.

3.3 FIELD QUALITY CONTROL

A. Sampling Protocol: Random location selection, ASTM D 3665. Sample collection, ASTM D 75.

B. Testing Protocol: Gradation, ASTM C 136. Field density, ASTM D 2922. Moisture content, ASTM D 3017.

3.4 REPAIR OR REMOVAL

A. If product is correctable and at no additional cost to OWNER, provide laboratory data showing design CBR has not been reduced and material in-place has been compacted to 97 percent minimum.

B. Remove any product that cannot be corrected and install acceptable product at no additional cost to OWNER.

END OF SECTION

SECTION 32 12 03
ASPHALT BINDERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. An asphalt-based cement that is produced from petroleum residue either with or without the addition of non-particulate, non-fibrous organic modifiers.

B. Requirements for accepting non-complying asphalt binders.

1.2 REFERENCES

A. **ASTM Standards**:

D 113 Ductility of Bituminous Materials.

D 977 Emulsified Asphalt.

D 2026 Cutback Asphalt (Slow-Curing Type).

D 2027 Cutback Asphalt (Medium-Curing Type).

D 2028 Cutback Asphalt (Rapid-Curing Type).

D 2397 Cationic Emulsified Asphalt.

D 3381 Viscosity-Graded Asphalt Cement for Use in Pavement Construction.

D 4552 Classifying Hot-Mix Recycling Agents.

D 5710 Trinidad Lake Modified Asphalt.

D 6373 Performance Graded Asphalt Binder.

1.3 SUBMITTALS

A. Submit bill of lading for each shipment of asphalt binder from vendor. Identify the following:

1. Source of product (manufacturer);
2. Type and grade of asphalt, and
3. Type and amount of additives in the product.

1.4 QUALITY ASSURANCE

A. Reject asphalt binders that are not uniform in appearance and consistency or foams at hot mixing temperature.

B. Do not use storage containers contaminated with other types or grades of petroleum products.

C. Do not use petroleum product that does not comply with contract requirements.

1.5 ACCEPTANCE

A. General:

1. Acceptance is by Lot. One (1) Lot is one (1) day production.
2. If non-complying material has been installed and no price for the material is specified, apply pay adjustment against cost of work requiring material as part of its installation. Section 01 29 00
3. Dispute resolution, Section 01 35 10.

B. Performance Graded Asphalt Binder (PGAB): Sub-lot size is 20,000 gallons. Collect sub-lot Samples randomly from oil storage unit.

1. Meet limits published in Section 209 of UDOT's "Manual of Instruction, Part 8 Materials". Pay reductions are as follows:
   a. If none of the critical properties are outside rejection limit a composite pay adjustment of 25 percent or less is allowed.
   b. If one or more of the critical properties falls outside the rejection limit or if a composite pay adjustment is more than 25 percent, asphalt binder will be rejected.

C. Asphalt Cement (AC) Binder: Sub-lot size is 20,000 gallons. Collect sub-lot Samples randomly from oil storage unit.

1. Ductility: Meet this section's requirements, <u>or</u>
2. Viscosity or Penetration: Meet graphics published in Section 955 of UDOT's "Manual of Instructions, Part 8 Materials":
   a. Lot may be accepted using the published graphics. If pay adjustment exceeds 30 percent, reject asphalt binder, or
   b. If allowed to remain after placement, pay adjustment will be 50 percent.

D. Cut-back Binder: Meet this section's requirements for ductility.

E. Trinidad Lake Modified Asphalt: Supplier's certificate for ASTM compliance.

F. Emulsified Asphalt: Supplier's certificate for ASTM compliance.

G. Recycle Asphalt: Identity of source (asphalt cement or tar products).

H. Crack Patch: Meet material requirements in Section 32 01 17.

PART 2 PRODUCTS

2.1 PERFORMANCE GRADE ASPHALT BINDER (PGAB)

A. Petroleum asphalt that complies with ASTM D 6373. Blending binder with polymers, crumb rubber, or natural asphalts is CONTRACTOR's choice.

2.2 ASPHALT CEMENT (AC)

A. Petroleum asphalt that complies with Table 2 of ASTM D 3381 except as follows:

1. Replace ductility, ASTM D 113, at 77 deg F (25 deg. C.) with ductility at 39.2 deg F (4 deg. C.). Use the following values.
   - AC-5: greater than 25.
   - AC-10: greater than 15.
   - AC-20: greater than 5.
2. Delete the loss on heating requirement on residue from "Thin-Film Oven Test".

B. AC-5 Latex Additive: Anionic emulsion of butadiene-styrene low-temperature copolymer consisting of two (2) percent by weight (solids basis), stabilized with fatty-acid soap for storage stability.

2.3 TRINIDAD LAKE MODIFIED ASPHALT (TLA)

A. Petroleum asphalt that complies with ASTM D 5710 (a blend of natural asphalts).

2.4 SLOW CURE CUT-BACK ASPHALT (SC)

A. Petroleum asphalt that complies with ASTM D 2026 (fluxed with a light oil) except if penetration of residue is more than 200 and its ductility at 77 deg. F (25 deg. C) is less than 100 cm., the material will be acceptable if the ductility at 59 deg F (15 deg. C) is greater than 100.

2.5 MEDIUM CURE CUT-BACK ASPHALT (MC)

A. Petroleum asphalt that complies with ASTM D 2027 (fluxed or blended with a kerosene type solvent, non-foaming when heated to application temperature) except if penetration of residue is more than 200 and its ductility at 77 deg F (25 deg. C) is less than 100 cm., the material will be acceptable if the ductility at 59 deg F (15 deg. C) is greater than 100.

2.6 RAPID CURE CUT-BACK ASPHALT (RC)

A. Petroleum that complies with ASTM D 2028 asphalt (fluxed or blended with a naphtha solvent, non-foaming when heated to application temperature).

2.7 EMULSIFIED ASPHALT

A. Petroleum asphalt uniformly emulsified with water, homogeneous throughout, and when stored, shows no separation within 30 days after delivery. Frozen emulsions not accepted:

1. Anionic, ASTM D 977 (breaks by evaporation).
2. Cationic, ASTM D 2397 (breaks chemically).

2.8 RECYCLE ASPHALT (RA)

A. Petroleum asphalt that complies with ASTM D 4552 (homogeneous, free-flowing at pumping temperature made from maltene fractions of asphalt cement for surface revitalization or from tar products to make Pavements resistant to fuel spillage:

1. RA-1, RA-5, RA-25 or RA-75 for recycling RAP aggregate when less than 30 percent virgin aggregate is added.
2. RA-250 or RA-500 when more than 30 percent virgin aggregate is added to RAP.

2.9 WARM-MIX ASPHALT (WMA)

A. Performance grade asphalt binder or asphalt cement binder blended with a wax, foam, chemical, or organic additive.

PART 3 EXECUTION

3.1 INSTALLATION

A. Prime coat, Section 32 12 13.19.

B. Tack coat, Section 32 12 13.13.

C. Plant mix paving, Section 32 12 16.13.

D. Road mix paving, Section 32 12 16.19.

E. Slurry seal coating, Section 32 01 13.61.

F. Crack sealing, Section 32 01 17.

END OF SECTION

SECTION 32 12 05
BITUMINOUS CONCRETE

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Composition of an aggregate and Bituminous Binder mix.

1.2 **REFERENCES**

A. **AASHTO Standards**:

M 323 Superpave Volumetric Mix Design, Single User Digital Publication.

R 30 Mixture Conditioning of Hot-Mix Asphalt (HMA).

T 312 Preparing and Determining the Density of Hot-Mix Asphalt (HMA) Specimens by Means of the Superpave Gyratory Compactor.

T 324 Hamburg Wheel-Track Testing of Compacted Hot-Mix Asphalt (HMA).

B. **ASTM Standards**:

C 29 Unit Weight and Voids in Aggregate.

C 88 Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.

C 117 Materials Finer Than 0.075mm (No. 200) Sieve in Mineral Aggregates by Washing.

C 131 Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

C 136 Standard Method for Sieve Analysis of Fine and Coarse Aggregate.

C 142 Clay Lumps and Friable Particles in Aggregates.

D 75 Sampling Aggregates.

D 140 Sampling Bituminous Materials.

D 242 Mineral Filler for Bituminous Paving Mixtures.

D 979 Sampling Bituminous Paving Mixtures.

D 995 Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures.

D 2041 Theoretical Maximum Specific Gravity of Bituminous Paving Mixtures.

D 2419 Sand Equivalent Value of Soils and Fine Aggregate.

D 3203 Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures.

D 3515 Hot-Mixed, Hot-Laid Bituminous Paving Mixtures.

D 3665 Random Sampling of Construction Materials.

D 3666 Minimum Requirements for Agencies Testing and Inspecting Bituminous Paving Materials.

D 4318 Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

D 4552 Classifying Hot-Mix Recycling Agents.

D 4791 Flat or Elongated Particles in Coarse Aggregate.

D 4867 Effect of Moisture on Asphalt Concrete Paving Mixtures.

D 5444 Mechanical Size Analysis of Extracted Aggregate.

D 5821 Determining the Percentage of Fractured Particles in Coarse Aggregate.

D 6307 Determining Asphalt Content of Hot-Mix Asphalt by Ignition Method.

D 6373 Performance Graded Asphalt Binder.

D 6927 Marshall Stability and Flow of Bituminous Mixtures.

C. **AI Standards**:

MS-2 Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types.

SP-2 Superpave Series No. 2.

1.3 **DEFINITIONS**

A. **Aggregate and Binder Designator**: An Alphanumeric code used to indicate a bituminous mix is composed of 1) a type and grade of aggregate and 2) a type or a type and grade of a Bituminous Binder. The aggregate portion of the code is specified in English units indicating a Marshall mix design is required or in metric units indicating a Superpave mix design is required. The bituminous portion of the code indicates the binder is an Asphalt Binder, a Bitumen Binder, or a Blended Binder. For example.

1. Marshall mix design.
   - **DM 3/4 PG70-28:** DM 3/4 is the aggregate. PG70-28 is the Asphalt Binder.
   - **DM 1/2 OS/PG:** DM 1/2 is the aggregate. OS/PG is a Blended Binder.
2. Superpave mix design.
   - **12.5 PG64-22:** 12.5 is the aggregate. PG64-22 is the Asphalt Binder.
   - **9.5 OS/PG:** 9.5 is the aggregate. OS/PG is a Blended Binder.

B. **Bituminous Binder**:

1. Asphalt Binder: Refined or manufactured asphalt cement (AC) or performance graded asphalt binder (PG or PGAB) whether virgin or contained in RAP.
2. Bitumen Binder: Natural bitumen cement contained in an Oil Sand.
3. Blended Binder: Binder comprised of both Asphalt Binder and Bitumen Binder.

C. **ESAL** (acronym for equivalent single axle load): Number used in designing pavement thickness. It relates axle load of any mass and number to an equivalent number (18,000 lb).

D. **Mean of Deviations**: Defined in Section 32 11 23.

E. **Nominal Maximum Size**: One sieve size larger than first sieve size retaining more than 10 percent of the sample. The nominal maximum size sieve will retain more than zero (0) percent of the sample and a maximum of 10 percent of the sample. The maximum size will be one (1) sieve size larger than the nominal maximum size.

F. **Oil Sand (OS)**: Naturally occurring sediments or sedimentary rock containing gravel, sand, clay, water and Bitumen Binder.

G. **RAP** (acronym for reclaimed asphalt pavement): A granular product recovered from a bituminous pavement containing aggregate and an Asphalt Binder.

H. **ROSP** (acronym for reclaimed Oil Sand pavement): A granular product recovered from a bituminous pavement containing an aggregate and a Bitumen Binder.

1.4 SUBMITTALS

A. **General**:

1. Allow ENGINEER 10 days to evaluate mixing equipment and mix design submittals.
2. Once a mix design is accepted, a new mix design submittal is required if the following occurs.
   a. Asphalt Binder grade is changed.
   b. Aggregate source is changed. When this occurs, submit a physical properties report on the proposed aggregates.

B. **Independent Laboratory**: Submit names, certification levels, and years of experience of testing agency's field technicians that are assigned to the Work. Verify laboratory complies with ASTM standards.

C. **Mix Production Equipment**: Submit verification by an individual acceptable to ENGINEER, that plant equipment complies with requirements of ASTM D 995.

D. **Mix Design**: Submit the following.

1. Date of mix design. If the date exceeds the following times, the mix design is invalid and must be recertified.
   a. One (1) year for non-commercial plants.
   b. Two (2) years for commercial plants if there is no change in the aggregate source. A new mix design will be required if aggregate source is changed.
2. Asphalt Binder source, type, chemical composition, and grade. Disclose if RAP or ROSP is used in the mix.
3. Optimum compaction temperature at the project site.
4. Compaction density at N_{design} (for Superpave mix design).
5. Target Grading Curve for aggregate.
6. Binder target percentage, dust to binder ratio, and the following as applicable.
   a. For Marshall mix design provide 1) tensile strength ratio (moisture sensitivity), 2) voids in the mineral aggregate (VMA), 3) stability, 4) flow and 5) voids in the bituminous mix.
   b. For Superpave mix design provide 1) voids in the mineral aggregate (VMA), and 2) voids filled with Bituminous Binder (VFA).
7. Percentages of 1) mineral filler, 2) anti-strip, 3) reclaimed bituminous pavement (RAP or ROSP), and 4) recycle agent in the mix.
8. Aggregate physical properties (this section article 2.2). The information is for suitability of source and not for project control. A new report may be required if aggregate source is changed. Test results shall not be older than 455 days from the date of submission.

E. **Pre-approved Mix Design**: Submit name and address of Supplier.

F. **Testing Report**: If requested by ENGINEER, submit a report of source and field quality control testing performed by CONTRACTOR and Suppliers.

1.5 QUALITY ASSURANCE

A. Use a laboratory that complies with ASTM D 3666 and follows Section 01 45 00 requirements.

B. Do not change aggregate source or binder source until ENGINEER accepts new sources and mix design.

1.6 ACCEPTANCE

A. General:

1. Acceptance is by Lot. One (1) Lot is one (1) day production.
2. If non-complying material has been installed and no price for the material is specified, apply pay adjustment against cost of work requiring material as part of its installation, Section 01 29 00.
3. If test results are not within this section's limits, options include correction of production procedures or production of an alternate mix design acceptable to ENGINEER.
4. Observation of CONTRACTOR's field quality control testing does not constitute acceptance. Such testing; however, may be used by ENGINEER for acceptance if requirements in Section 01 35 10 are met.
5. Dispute resolution, Section 01 35 10.

B. Mix:

1. Sub-lot size is 500 tons or part thereof.
2. Sampling Protocol: ASTM D 3665 and ASTM D 979. Collect at least one (1) random Sample per sub-lot from the following locations:
   a. Behind paver before compaction, or
   b. Where sub-lot exhibits non-uniform appearance.
3. Testing Protocol: Field samples will be compacted in the laboratory and tested for:
   a. Air voids, ASTM D 3203.
   b. Dust to binder ratio.
   c. Binder content, ASTM D 6307 and aggregate gradation, ASTM D 5444.

C. Pay Reduction: Lot is acceptable if test deviations are within pay factor 1.00 limits in Table 1 or Table 2 as applicable. At ENGINEER's discretion a Lot with a sub-lot test deviation greater than pay factor 0.85 limits may stay in place at 50 percent pay.

Table 1 – Pay Factors – Marshall Mix Design						
Criteria	Pay Factor	Range of Mean of Deviations of Tests Results from the Binder and Gradation Targets in Percentage Points				
		500 Tons	1,000 Tons	1,500 Tons	2,000 Tons	≥2,500 Tons
Binder Content	1.00	0.00–0.70	0.00–0.54	0.00–0.46	0.00–0.41	0.00–0.38
	0.975	0.71–0.80	0.55–0.61	0.47–0.52	0.42–0.46	0.39–0.43
	0.95	0.81–0.90	0.62–0.68	0.53–0.58	0.47–0.52	0.44–0.47
	0.90	0.91–1.00	0.69–0.75	0.59–0.64	0.53–0.56	0.48–0.52
	0.85	1.01–1.10	0.76–0.82	0.65–0.69	0.57–0.61	0.53–0.56
1/2"and larger Sieve	1.00	0.0–10.9	0.0–7.3	0.0–6.5	0.0–5.6	0.0–5.2
	0.975	11.0–12.9	7.4–8.3	6.4–7.1	5.7–6.3	5.3–5.8
	0.95	13.0–13.9	8.4–9.3	7.2–7.9	6.4–7.0	5.9–6.4
	0.90	14.0–14.9	9.4– 10.3	8.0–8.7	7.1–7.7	6.5–7.1
	0.85	15.0–16.0	10.4–11.3	8.8–9.5	7.8–8.4	7.2–7.7
3/8" Sieve	1.00	0.0–9.9	0.0–6.9	0.0–5.9	0.0–5.3	0.0–4.9
	0.975	10.0–10.9	7.0–7.8	6.0–6.6	5.4–6.9	5.0–5.5
	0.95	11.0–11.9	7.9–8.7	6.7–7.3	6.0–6.6	5.6–6.1
	0.90	12.0–13.9	8.8–9.6	7.4–8.0	6.7–7.2	6.2–6.6
	0.85	14.0–15.0	9.7–10.5	8.1–8.9	7.3–7.9	6.7–7.2
No. 4 Sieve	1.00	0.0–9.9	0.0–6.7	0.0–5.7	0.0–5.2	0.0–4.8
	0.975	10.0–11.0	6.8–7.6	5.8–6.3	5.3–5.8	4.9–5.4
	0.95	11.1–11.9	7.7–8.5	6.4–6.9	5.9–6.4	5.5–5.9
	0.90	12.0–12.9	8.6–9.4	7.0–7.5	6.5–7.0	6.0–6.5
	0.85	13.0-14.0	9.5–10.2	7.6–8.0	7.1–7.6	6.6–7.0
No. 8 Sieve	1.00	0.0–7.9	0.0–5.6	0.0–4.8	0.0–4.3	0.0–4.0
	0.975	8.0–8.9	5.7–6.3	4.9–5.4	4.4–4.8	4.1–4.5
	0.95	9.0–9.9	6.4–7.0	5.5–6.0	4.9–5.3	4.6–4.9
	0.90	10.0–10.9	7.1–7.7	6.1–6.6	5.4–5.8	5.0–5.4
	0.85	11.0–12.0	7.8–8.5	6.7–7.2	5.9–6.4	5.5–5.8
No. 16 Sieve	1.00	0.0–7.9	0.0–5.2	0.0–4.6	0.0–4.2	0.0–3.9
	0.975	8.0–8.9	5.3–5.8	4.7–5.1	4.3–4.6	4.0–4.3
	0.95	9.0–9.9	5.9–6.4	5.2–5.6	4.7–5.1	4.4–4.7
	0.90	10.0–10.9	6.5–7.0	5.7–6.1	5.2–5.5	4.8–5.1
	0.85	11.0–12.0	7.1–7.6	6.2–6.6	5.6–5.9	5.2–5.4
No. 50 Sieve	1.00	0.0–6.9	0.0–4.3	0.0–3.8	0.0–3.4	0.0–3.2
	0.975	7.0–7.9	4.4–4.8	3.9–4.1	3.5–3.8	3.3–3.5
	0.95	8.0–8.9	4.9–5.3	4.2–4.5	3.9–4.1	3.6–3.8
	0.90	9.0–9.9	5.4–5.8	4.6–4.9	4.2–4.4	3.9–4.1
	0.85	10.0–11.0	5.9–6.4	5.0–5.5	4.5–4.9	4.2–4.5
No. 200 Sieve	1.00	0.0–3.0	0.0–2.4	0.0–2.0	0.0–1.8	0.0–1.7
	0.975	3.1–3.5	2.5–2.7	2.1–2.2	1.9–2.0	1.8–1.9
	0.95	3.6–4.0	2.8–3.0	2.3–2.4	2.1–2.2	2.0–2.1
	0.90	4.1–4.5	3.1–3.3	2.5–2.7	2.3–2.4	2.2–2.3
	0.85	4.6–5.0	3.4–3.6	2.8–3.0	2.5–2.6	2.4–2.5

NOTES
(a) Test binder content using a burn-off oven, ASTM D 6307.
(b) Determine aggregate gradation by extraction, ASTM D 5444.

Table 2 – Pay Factors – Superpave Mix Design					
Criteria	**Pay Factor**	**Range of Mean of Deviations of Tests Results in Percentage Points from Binder and Gradation Targets**			
		500 Tons	**1,000 Tons**	**1,500 Tons**	**≥ 2,000 Tons**
Binder Content	1.00	0.0 – 0.7	0.0 – 0.54	0.0 – 0.46	0.0 – 0.41
	0.975	0.71 – 0.8	0.55 – 0.61	0.47 – 0.52	0.42 – 0.46
	0.95	0.81 – 0.9	0.62 – 0.68	0.53 – 0.58	0.47 – 0.52
	0.90	0.9 – 1.0	0.69 – 0.75	0.59 – 0.64	0.53 – 0.56
	0.85	1.01 – 1.1	0.76 – 0.82	0.65 – 0.69	0.57 – 0.61
≥ 12.5 mm Sieve	1.00	0.0 – 10.0	0.0 – 7.3	0.0 – 6.3	0.0 – 0.56
	0.975	11.0 – 12.0	7.4 – 8.3	6.4 – 7.1	5.7 – 6.3
	0.95	13.0 – 13.9	8.4 – 9.3	7.2 – 7.9	6.4 – 7.0
	0.90	14.0 – 14.9	9.4 – 10.3	8.0 – 8.7	7.1 – 7.7
	0.85	15.0 – 16.0	10.4 – 11.3	8.8 – 9.5	7.8 – 8.4
9.5 mm Sieve	1.00	0.0 – 9.9	0.0 – 6.9	0.0 – 5.9	0.0 – 5.3
	0.975	10.0 – 10.9	7.0 – 7.8	6.0 – 6.6	5.4 – 5.9
	0.95	11.0 – 11.9	7.9 – 8.7	6.7 – 7.3	6.0 – 6.6
	0.90	12.0 – 13.9	8.8 – 9.6	7.4 – 8.0	6.7 – 7.2
	0.85	14.0 – 15.0	9.7 – 10.5	8.1 – 8.9	7.3 – 7.9
4.75 mm Sieve	1.00	0.0 – 9.9	0.0 – 6.7	0.0 – 5.7	0.0 – 5.2
	0.975	10.0 – 10.9	6.8 – 7.6	5.8 – 6.3	5.3 – 5.8
	0.95	11.0 – 11.9	7.7 – 8.5	6.4 – 6.9	5.9 – 6.4
	0.90	12.0 – 12.9	8.6 – 9.4	7.0 – 7.5	6.5 – 7.0
	0.85	13.0 – 14.0	9.5 – 10.2	7.6 – 8.0	7.1 – 7.6
2.36 mm Sieve	1.00	0.0 – 7.9	0.0 – 5.6	0.0 – 4.8	0.0 – 4.3
	0.975	8.0 – 8.9	5.7 – 6.3	4.9 – 5.4	4.4 – 4.8
	0.95	9.0 – 9.9	6.4 – 7.0	5.5 – 6.0	4.9 – 5.3
	0.90	10.0 – 10.9	7.1 – 7.7	6.1 – 6.6	5.4 – 5.8
	0.85	11.0 – 12.0	7.8 – 8.5	6.7 – 7.2	5.9 – 6.4
0.075 mm Sieve	1.00	0.0 – 3.0	0.0-2.4	0.0 – 2.0	0.0 – 1.8
	0.975	3.1 – 3.5	2.5 – 2.7	2.1 – 2.2	1.9 – 2.0
	0.95	3.6 – 4.0	2.8 – 3.0	2.3 – 2.4	2.1 – 2.2
	0.90	4.1 – 4.5	3.1 – 3.3	2.5 – 2.7	2.3 – 2.4
	0.85	4.6 – 5.0	3.4 – 3.6	2.8 – 3.0	2.5 – 2.6

NOTES
(a) Test binder content using a burn-off oven, ASTM D 6307.
(b) Determine aggregate gradation by extraction, ASTM D 5444.

D. **Installation**: Acceptance requirements are stipulated in Section 32 12 16.13.

PART 2 PRODUCTS

2.1 BINDER

A. Bitumen Binder. Source is CONTRACTOR's choice.

B. Performance Graded Asphalt Binder (PGAB), ASTM D 6373:

1. Blending with polymers is allowed.
2. Do not use acid blends without documentation supporting need.
3. As a rule of thumb, if the two numbers in an binder designation are added together and are greater than 90, then the binder will most likely contain a polymer or natural bitumen.
4. Performance graded asphalt binder (PGAB) should be substituted for asphalt cement (AC) as follows.

Asphalt Cement	Substitute
AC-10	PG58–22 or PG58–28
AC-20	PG64-22

C. Blended Binder: CONTRACTOR's choice. A blended ratio of Asphalt Binder to Bitumen Binder in the range of about 1:4 to about 4:1 may require patent licensure (Reference: US RE39,289 E). CONTRACTOR to verify.

2.2 AGGREGATE

A. Crushed stone, crushed gravel, slag, sand, or combination.

Table 3 – Aggregate Physical Properties

Property	ASTM	ESAL	Min	Max
Coarse Aggregate				
Angularity (fractured faces), percent	D5821	less than 0.3	55	--
		0.3 to 3.0	75	--
		greater than 3.0	85/80	--
Wear (hardness or toughness), percent	C131	less than 0.3	--	40
		0.3 to 3.0	--	35
		greater than 3.0	--	35
Flats or elongates (3:1 length to width), percent	D4791	--	--	20
Fine Aggregate				
Angularity (uncompacted void content), percent (AASHTO T304)	--	less than 0.3	--	--
		0.3 to 3.0	40	--
		greater than 3.0	45	--
Sand equivalent, percent	D 2419	less than 0.3	40	--
		0.3 to 3.0	40	--
		greater than 3.0	45	--
Friable Particles, percent	C 142	--	--	2
Plasticity Liquid limit	D 4318	--	--	25

	Plastic limit	D 4318	--	--	6

NOTES

(a) ESAL in millions.

(b) Angularity by weight retained above the No. 8 (2.38mm) sieve, with at least one fractured face. 85/80 denotes 85 percent coarse aggregate has one fractured face and 80 percent has two or more fractured faces

(c) Wear of aggregate retained above No. 4 (4.76 mm) sieve unless specific aggregates have higher values are known to be satisfactory.

(d) Flats or elongates retained above the 3/8 (9.5mm) sieve.

(e) Friable particles passing the No. 4 (4.76) sieve.

(f) Plasticity, passing No. No. 40 (0.42mm) sieve. Aggregate is non-plastic even when filler material is added to the aggregate.

2.3 ADDITIVES

A. Mineral Filler: ASTM D 242.

B. Recycle Agent: ASTM D 4552.

C. Anti-strip Agent: Heat stable cement slurry, lime slurry, or chemical liquid.

D. RAP or ROSP: Free of detrimental quantities of deleterious materials, with a minimum sand equivalent value of 50.

1. Allowed up to 15 percent by weight with no change in specified binder grade.
2. Allowed from 15 to 30 percent by weight if the binder grade is adjusted according to AASHTO M 323 to meet the specified binder grade.

2.4 MIX DESIGN

A. **Materials**:

1. Bituminous Binder.
   a. Bitumen Binder: CONTRACTOR's choice.
   b. Asphalt Binder: Unless indicated otherwise select according to the following climate conditions. If necessary, adjust binder grade according to AASHTO M 323 to account for any binder stiffness caused by RAP or ROSP aggregate addition.
      1) Cold climate: PG58-28.
      2) Moderate climate: PG64-22.
      3) Hot climate: PG64-22.
   c. Blended Binder: This section article 2.1.
2. Aggregate: This section article 2.2.
3. Additives: This section article 2.3. Add cement, hydrated lime, or chemical liquid if mix is moisture sensitive.

B. **Aggregate Structure**:

1. **Gradation – Marshall Mix Design**: Target Grading Curve must lie within one of the Master Grading Bands in the following table. Target Grading Band for each sieve is defined under pay factor 1.00 limits in Table 1.

Table 4 – Master Grading Bands – Marshall Mix Design							
Sieve	Dense				Open	Friction	
	DM-1	DM-3/4N	DM-3/4	DM-1/2	OM-1/2	FM-1	FM-2
1 inch	100						
3/4 inch		100	100			100	
1/2 inch	75 – 91	74 – 99		100	100	90 – 100	100
3/8 inch		69 – 91	75 – 91		93 – 100	60 – 100	90 – 100
No. 4	47 – 61	49 – 65	46 – 62	60 – 80	36 – 44	15 – 40	30 – 50
No. 8		33 – 47			14 – 21	4 – 12	5 – 15
No. 16	23 – 33	21 – 35	22 – 34	28 – 42			
No. 50	12 – 22	6 – 18	11 – 23	11 – 23			2 – 5
No.200	3 – 7	2 – 6	3 – 7	3 – 7	2 – 4	2 – 5	

NOTES
(a) It is assumed fine and coarse aggregate have same bulk specific gravity.
(b) Friction Mixture, ASTM D 3515.
(c) DM -3/4N is 100% crushed.
(d) Gradation is expressed in percent passing by weight, ASTM C 136. Percentage of fines passing No. 200 sieve determined by washing, ASTM C 117.

2. **Gradation – Superpave Mix Design**: Target Grading Curve must lie within one of the Master Grading Bands in the following table. It must lie below the restricted zone if ESAL is 30 million or more, otherwise it may lie above, below, or pass through the zone. Target Grading Band for each sieve is defined under pay factor 1.00 limits in Table 2.

Table 5 – Master Grading Bands – Superpave Mix Design					
Sieve (mm)		Aggregate Grade			
		25.0	19.0	12.5	9.5
Control Sieves	37.5	100.0	–	–	–
	25	90 – 100	100.0	–	–
	19	< 90	90 – 100	100	–
	12.5	–	< 90	90 – 100	100
	9.5	–	–	< 90	90 – 100
	4.75	–	–	–	< 90
	2.36	19 – 45	23 – 49	28 – 58	32 – 6
	0.075	1 – 7	2 – 8	2 – 10	2 – 10
Restricted Zone	4.75	39.5	–	–	–
	2.36	29.8 – 30.8	34.6	39.1	47.2
	1.18	18.1 – 24.1	22.3 – 28.3	25.6 – 31.6	31.6 – 37.6
	0.6	13.6 – 17.6	16.7 – 20.7	19.1 – 23.1	23.5 – 27.5
	0.3	11.4	13.7	15.5	18.7

NOTES
(a) It is assumed fine and coarse aggregate have same bulk specific gravity.
(b) Gradation is expressed in percent passing by weight, ASTM C 136. Percentage of fines passing No. 200 (0.075 mm) control sieve determined by washing, ASTM C 117.

3. **Blended Physical Properties:**

Table 6 – Aggregate Physical Properties			
Property	**ASTM**	**Min**	**Max**
Dry-rodded Unit Weight, lb/ft^3	C29	75	--
Weight Loss (Soundness), percent	C88	--	16
Clay content or cleanliness (sand equivalent), percent	D 2419		
ESAL less than 0.3 million		45	--
ESAL more than 0.3 million		60	--
Friable particles (deleterious materials), percent	C142	--	2

NOTES
(a) Weight loss using sodium sulfate.
(b) Sand equivalent value is after going through the dryer or before the drum mixer. The sand equivalent requirement is waived for RAP or ROSP aggregate but applies to the remainder of the aggregate blend.
(c) Friable particles of clay lumps, shale, wood, mica, and coal passing the No.4 (2.36mm) sieve.

C. **Mix Properties – Marshall Mix Design**: Follow AI MS-2 and the following.

1. Air void target is four (4) percent.
2. Density target is 96 percent of maximum theoretical specific gravity (ASTM D 2041).
3. Stability, Flow, Voids: ASTM D 5581. If traffic classification is not specified elsewhere, use Medium Traffic Classification.

Table 7 – Stability, Flow, Voids, VMA Limits			
Criteria	**Traffic Classifications**		
	Light	**Medium**	**Heavy**
Number of compaction blows each end of specimen	35	50	75
Stability, lbs., minimum	750	1200	1800
Flow, in 0.01 inch units	10 – 18	10 – 18	10 – 18
Voids in Mineral Aggregate (VMA), percent minimum			
1" maximum aggregate particle size	13	13	13
3/4" maximum aggregate particle size	14	14	14
1/2" maximum aggregate particle size	15	15	15
3/8" maximum aggregate particle size	16.5	16.5	16.5
Voids in Bituminous Mix, percent	3 – 5	3 – 5	3 – 5

NOTES
(a) Traffic Classifications:
Light: (ESAL $<10^4$ per year)
Class I: Parking lots, Driveways, light traffic residential streets, light traffic farm roads.
Medium: (ESAL between 10^4 and 10^6 per year)
Class II: Residential streets, rural farm and residential roads.
Class III: Urban minor collector streets, rural minor collector roads.
Heavy: (ESAL $>10^6$ per year)
Class IV: Urban minor arterial and light industrial and light industrial streets, rural major collector and minor arterial highways.
Class V: Urban major arterial and heavy industrial streets.

(b)	Stability, Flow, Voids: ASTM D 6927.
(c)	VMA: ASTM D 3203

4. Dust to binder Ratio: 0.8 to 1.6.
5. Tensile Strength Ratio (moisture sensitivity): 0.80 or greater using freeze-thaw conditioning, ASTM D 4867. Compact test specimen to seven (7) percent plus or minus one (1) percent air voids.

D. **Mix Properties – Superpave Mix Design**: Follow AI SP-2 and the following.

1. Air void target is 3.5 percent.
2. Density target is 96.5 percent of maximum theoretical specific gravity (ASTM D 2041).at N_{design}.
3. Compaction effort is for a 20 year design ESAL.

Table 8 – Compaction Parameters

20 Year design ESALs (Million)	$N_{initial}$/ % of G_{mm}	N_{design}/ % of G_{mm}	N_{max}/ % of G_{mm}
Less than 0.3	6 / ≤ 91.5	50 / 96.5	75 / ≤ 98
0.3 to <3	7 / ≤ 90.5	75 / 96.5	115 / ≤ 98
3 to <30	8 / ≤ 89	100 / 96.5	160 / ≤ 98
30 or more	9 / ≤ 89	125 / 96.5	205 / 98

NOTES

(a) N = Number of gyrations.
(b) G_{mm} = Maximum specific gravity of mix, ASTM D 2041 (Rice method).
(c) Specific gravity of specimen: AASHTO T 312.
(d) 20 year design ESALs defined as follows.
- Less than 0.3 = Very light traffic (local / county roads; city streets where truck traffic is prohibited).
- 0.3 to 3 = Medium traffic (collector roads; most county roadways)
- 3 to 30 = Medium to high traffic (city streets, state routes; US highways; some rural interstates).
- 30 or more = High traffic (most of the interstate system; climbing lanes; truck weighing stations).

4. Voids in the mineral aggregate (VMA) at N_{design} based upon the bulk specific gravity of the aggregate at surface saturated dry (SSD) condition.

Nominal Maximum Size *	Voids (VMA)
37.5 mm	11.5 to 13 percent
25.0 mm	12.5 to 14 percent
19.0 mm	13.5 to 15 percent
12.5 mm	14.5 to 16 percent
9.5 mm	16.5 percent minimum

* Maximum size is one sieve larger than the nominal maximum size.

5. Voids filled with binder (VFA) at N_{design}:

20 Year Design ESALs (million)	Voids Filled with Binder (VFA)
Less than 0.3	70 – 80 percent
0.3 to <3	65 – 78 percent
3 to < 30	65 – 75 percent
30 or more	65 – 75 percent

   a. For 9.5mm nominal maximum size mixtures, the specified VFA range is 73 percent to 76 percent for design traffic levels 3 million ESALs or greater.
   b. For 25.0mm nominal maximum size mixtures, the specified lower limit of the VFA is 67 percent for design traffic levels less than 0.3 million ESALs.
   c. For 37.5mm nominal maximum size mixtures, the specified lower limit of the VFA is 64 percent for all design traffic levels.

6. Dust to Binder Ratio:
   a. 0.6 to 1.2 if aggregate gradation passes through or over the restricted zone.
   b. 0.8 to 1.6 if aggregate gradation passes under the restricted zone.

7. Moisture Sensitivity and Rutting: With testing performed at temperatures representing the specified binder grade in the Hamburg rut test (AASHTO T 234), the average rut depth of three (3) mix design test Samples is less than the following.
   - Residential Streets: 15 mm at 10,000 passes.
   - Non-residential Streets: 15 mm at 20,000 passes.

2.5 SOURCE QUALITY CONTROL

A. Collect Samples randomly, ASTM D 3665. Do not change sampling points:
   1. Sampling aggregate, ASTM D 75. Collect samples before the drum mixer or after going through the drier.
   2. Sampling binder, ASTM D 140.
   3. Sampling bituminous paving mixture, ASTM D 979.

B. Validate binder grade received from Supplier, Section 32 12 03.

C. Test mix every production day for the following:
   1. Combined aggregate gradation in the mix, ASTM D 5444.
   2. Binder content in the mix, ASTM D 6307.
   3. Temperature of mix placed in the transport vehicle at the production plant.
      a. Asphalt Binder mixes.
         1) Hot Mix: 350 deg F maximum.
         2) Warm Mix: 325 deg F maximum.
      b. Bitumen Binder mixes or Blended Binder mixes.
         1) Hot Mix: NOT ALLOWED.
         2) Warm Mix: 230 degrees maximum.

D. Warm Mix Testing: When rutting or moisture susceptibility tests are required on plant

produced warm mix, condition the warm mix material before testing for two (2) hours at 275 plus or minus five (5) deg F per AASHTO R30 (short term aging). The material may be cooled to room temperature before conditioning.

PART 3 EXECUTION

3.1 CONSTRUCTION EQUIPMENT

A. Mixing Plant: ASTM D 995. Provide.

1. Positive means to determine the moisture content of aggregate.
2. Positive means to sample all material components.
3. Sensors to measure the temperature of the mix at discharge.
4. Ability to maintain discharge temperature of mix.
5. Capability of maintaining plus or minus five (5) percent tolerance on component percentages in final mix.
6. Oil Sand Introduction System: **Do not burn off the light oils in the Oil Sand Bitumen Binder**.

3.2 INSTALLATION

A. Paving: Section 32 12 16.13.

B. Patches: Section 33 05 25.

END OF SECTION

SECTION 32 12 13.13
TACK COAT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Application of asphaltic material to existing asphalt concrete or portland cement concrete surfaces before placing an asphalt concrete pavement.

1.2 SUBMITTALS

A. Certificate showing asphaltic material complies with Section 32 12 03:

1. Identify water/asphalt dilution ratio.
2. Identify tack coat application rate.

B. Identify asphalt material recommended by fabric manufacturer.

1.3 WEATHER

A. Apply tack coat only when air and roadbed temperatures in the shade are greater than 40 deg F Temperature restrictions may be waived only with ENGINEER's concurrence.

B. Do not apply tack coat during rain, fog, dust, or other unsuitable weather. Do not apply coat to wet surfaces.

1.4 NOTICE

A. Send written notice to residents or business owners 24 hours before applying coat.

PART 2 PRODUCTS

2.1 ASPHALT MATERIAL

A. Select from the following:

1. Emulsified Asphalt: Grade MS-1, SS-1 or SS-1h, Section 32 12 03.
2. Cationic Emulsified Asphalt: Grade CSS-1 or CSS-1h, Section 32 12 03.
3. Rapid Cure Cutback Asphalt: Grade RC-70, Section 32 12 03.

PART 3 EXECUTION

3.1 PREPARATION

A. Select and advise ENGINEER of the type of tack material to be used.

B. Clean surface to be treated free of dust and other foreign material. If flushed, allow surface to dry. If leaves from trees, blow clean.

C. Provide safe pedestrian access across tack coat.

D. Prevent pedestrians, vehicles, pets, etc., access to tack surfaces.

3.2 APPLICATION

A. General:

1. Triple coverage by spray bar required. Stop application if any nozzle is not working properly.
2. Apply tack only to area covered with asphalt concrete in the same day.

B. Application Rate: Typically as follows:

1. Emulsions, 0.05 to 0.15 gallons per square yard.
2. Cutback, CONTRACTOR's choice.

C. Tack for Fabric Application: Comply with manufacturer's recommendation. If none, then as follows:

1. Dry pavement surface, 0.20 to 0.30 gallons per square yard. Within street intersections, on steep grades and in zones where vehicle speed changes are commonplace reduce application rate to no less than 0.20 gallons per square yard.
2. Heavy duty fabrics, 0.30 to 0.40 gallons per square yard.

3.3 PROTECTION

A. Protect all surfaces exposed to public view from being spattered or marred. Remove any spattering, over-coating, or marring.

B. Do not discharge bituminous material into borrow pits or gutters.

3.4 OPENING TO TRAFFIC AND MAINTENANCE

A. Do not permit traffic to travel over the tacked surface until bituminous tack coat has cured or is not picked up by traffic.

B. If detours cannot be provided, restrict operations to a width suitable at least for one-way traffic over the remaining portion of the road.

C. If one-way traffic is provided, control traffic appropriately.

END OF SECTION

SECTION 32 12 16.13
PLANT-MIX ASPHALT PAVING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Place an asphalt concrete mix (Superpave, oil sand, or asphalt concrete) in a base course, leveling course, surface course, overlay course or an inlay course.

1.2 REFERENCES

A. **AASHTO Standards**:

R 9 Acceptance Sampling Plans for Highway Construction.

TP 68 Bulk Specific Gravity and Density of Compacted Asphalt Mixtures Using Automatic Vacuum Sealing Method.

T 324 Hamburg Wheel-Track Testing of Compacted Hot-Mix Asphalt (HMA).

B. **ASTM Standards**:

D 979 Sampling Bituminous Paving Mixtures.

D 1188 Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Coated Samples.

D 2041 Theoretical Maximum Specific Gravity of Bituminous Paving Mixtures.

D 2725 Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures.

D 2950 Density of Bituminous Concrete In Place by Nuclear Method.

D 3549 Thickness or Height of Compacted Bituminous Paving Mixture Specimens.

D 3665 Random Sampling of Construction Materials.

D 5361 Sampling Compacted Bituminous Mixtures for Laboratory Testing.

D 6927 Marshall Stability and flow of Bituminous Mixtures.

E 950 Measuring the Longitudinal Profile of Traveled Surfaces with an Accelerometer Established Inertial Profiling Reference.

E 1274 Measuring Pavement Roughness Using a Profilograph.

1.3 **SUBMITTALS**

A. **Before Delivery**: Submit 48 hours before delivery:

1. Location and name of asphalt concrete production facility.
2. Mix design method.
3. Mix identification number or code.
4. Type, grade, and weight of asphalt.
5. Type, grade, and weight of aggregate.
6. Traffic control plan, Section 01 55 26.
7. Type and number of rollers.
8. Manufacturer's certificate of compliance for paving geotextiles. (Refer to Section 31 05 19).
9. Certification of profilograph and profilograph operator.

B. **At Delivery**: For each batch delivered to site identify:

1. Date and project description.
2. Producer and plant.
3. Name of contractor.
4. Serial number of ticket.
5. Mix identification number or code.
6. Truck number and time dispatched.
7. Volume of asphalt concrete delivered.

C. **After Placement**: Submit:

1. Profile deviation report.
2. Profile roughness index report.

1.4 .**QUALITY ASSURANCE**

A. Do not change asphalt or aggregate sources until ENGINEER accepts new source and new mix design.

B. Reject product and work that does not meet requirements of this Section.

C. Remove product found defective after installation and install acceptable product at no additional cost to OWNER.

D. Foreman of paving crew has completed at least three (3) projects of similar size and nature.

E. If requested, submit a quality control and testing report describing source and field quality assurance activities performed by CONTRACTOR and Suppliers.

1.5 **WEATHER**

A. Temperature:

1. Do not pave until air temperature is 45 deg F. and rising.
2. Cease paving if air temperature falls below 50 deg F.
3. Do not pave if wind or ground cools mix material before

compaction.

B. Moisture: Do not pave if surface is wet or weather is unsuitable.

1.6 **NOTICE**

A. Follow Laws and Regulations concerning when and to whom notices are to be given. Send written notice at least three (3) days before start of paving.

B. Indicate paving time and when new surface can be used.

C. Warn of potential vehicle tow away and other construction issues affecting neighborhood.

D. Should work not occur on specified day, send a new notice.

1.7 **ACCEPTANCE**

A. General:

1. Acceptance is by Lot.
2. If non-complying material has been installed and no price for the material is specified, apply pay adjustment against cost of work requiring complying material as part of its installation, Section 01 29 00.
3. Dispute resolution, Section 01 35 10.
4. Opening a paved surface to traffic does not constitute acceptance.
5. Observation of CONTRACTOR's field quality control testing does not constitute acceptance. Such testing; however, may be used by ENGINEER for acceptance if requirements of Section 01 35 10 are met.

B. Mix Material: Accepted as specified for asphalt concrete, Section 32 12 05, Superpave, Section 32 12 06, oil sand asphalt concrete, Section 32 12 07, or rubberized asphalt concrete, Section 32 12 08.

C. Mix Temperature at Site:

1. Reject mixes in the transport material exceeding the following temperatures.
   a. Hot mix, 425 deg F.
   b. Warm mix, 300 deg F.
   c. Oil sand asphalt concrete, 230 deg F.
2. Dispose of cold mix in paver hopper as thin spread underlay.

D. Grade, Cross Slope: Verify tolerances are not exceeded.

E. Compaction: Options for acceptance are core density, non-destructive test density, or control strip density with visual observation. Use core density unless specified elsewhere. A Lot is acceptable if test densities are within pay factor 1.00 limits. At ENGINEER's discretion, a Lot with deficient sub-lot density tests may be accepted if pay is adjusted using an applicable pay factor in the following table, or accepted at 50 percent pay if a sub-lot is in Reject.

Table 1 – Compaction Pay Factors		
Pay Factor	**Density, in Percent Relative to ASTM D 2041**	
	Average	**Lowest Test**
0.70	More than 96	–
1.00	**92 to 96**	**89 or greater**
0.90	92 to 96	Less than 89
0.80	Less than 92	89 or greater
Reject	Less than 92	Less than 89

1. Core Density: This method compares the average density of cores extracted from a pavement surface to maximum theoretical density:
   a. Lot Size: One (1) day production with 1,000 square yard sub-lots or part thereof.
   b. Sampling Protocol: Use ASTM D 3665 to randomly select in each sub-lot at least one (1) surface test location and one (1) longitudinal joint test location. Collect at least two (2) test samples at each test location, ASTM D 5361. Samples are full depth or overlay depth in overlay construction.
   c. Testing Protocol: ASTM D 2725 for core density and ASTM D 2041 (Rice) for maximum theoretical density.
2. Non-Destructive Density Testing by Gage:
   a. Lot Size: One (1) day production with 1,000 square yard sub-lots or part thereof.
   b. Sampling Protocol: Use ASTM D 3665 to randomly select in each sub-lot at least one (1) surface test location and one (1) longitudinal joint test location.
   c. Testing Protocol: ASTM D 2950 (nuclear gage) or AASHTO TP 68 (non-nuclear gage) and ASTM D 2041 (Rice) for maximum theoretical density.
3. Control Strip Density with Visual Observation:
   a. Lot: One (1) day production.
   b. Sampling Protocol: Not required after rolling pattern is determined.
   c. Testing Protocol: ASTM D 6927 (Marshall) and D2041 (Rice method) to determine rolling pattern for 94 percent compaction, thereafter visual examination.
4. Compaction Dispute Resolution:

a. CONTRACTOR:

1) Hire an Independent Testing Agency, Section 01 45 00.

2) Take two (2) supplement cores midway between deficient acceptance test locations, and midway between a deficient test location and an adjacent acceptable test location.

3) Patch core holes.

4) Conduct testing at no additional cost to OWNER.

b. ENGINEER:

1) Accept Lot at full pay if new information shows compliance, or

2) Accept Lot at pay reduction using new test information, or

3) Reject Lot.

F. Thickness: A Lot is acceptable if test deficiencies are within pay factor 1.00 limits. At ENGINEER's discretion, a Lot with sub-lot deficiencies greater than allowed for pay factor 1 in the following table may be accepted if pay is adjusted using one of the following applicable pay factors, or accepted at 50 percent pay if a sub-lot is in Reject.

Table 2 – Thickness Pay Factor

Pay Factors	Deficiency Limits, in Inches
1.00	0.00 to 0.375
0.90	0.376 to 0.50
0.70	0.51 to 0.75
Reject	0.76 to 1.00

1. Lot Size: One (1) day production with 1,000 square yard sub-lots or part thereof.

2. Sampling Protocol: Use ASTM D 3665 to randomly select at least one surface test location and one longitudinal joint test location in each sub-lot. Collect at least two (2) core samples at each test location, ASTM D 5361. Samples are full depth. Overlay construction measured only on overlay portion of core sample.

3. Testing Protocol: ASTM D 3549:

a. Minimum Specified Thickness: A Lot specified to have minimum thickness will be accepted if all sub-lot measurements meet or exceed minimum. If thickness is deficient, additional material may be placed over the deficient thickness if there is no asphalt feathering; placement matches this section's thickness tolerance; surface continues to drain; and roughness tolerance is met.

b. Actual Specified Thickness: A Lot specified to have actual thickness is acceptable if any sub-lot measurement does not exceed deficiency limits for thickness pay factor 1.00.

4. Thickness Dispute Resolution:
   a. CONTRACTOR:
      1) Hire an Independent Testing Agency, Section 01 45 00.
      2) Take two (2) additioal cores midway between deficient acceptance test locations, and midway between a deficient test location and the next adjacent acceptable test location.
      3) Patch core holes.
      4) Conduct testing at no additional cost to OWNER.
   b. ENGINEER:
      1) Graph deficient areas by plotting new cores and original cores to define deficient areas assuming the following.
         a) The graph represents the thickness of the pavement.
         b) Thicknesses vary linearly along the pavement length from core depth to core depth.
         c) The pavement is a constant depth in the transverse direction.
      2) Accept Lot at full pay if new information shows compliance, or
      3) Accept Lot at pay reduction using new test information, or
      4) Reject Lot.

G. Roughness:
   1. Profile Roughness Index (PRI): Verify bumps and depressions are removed so profile roughness index in each lot meets tolerance:
      a. Lot is 0.1 lane mile (528 feet long one lane wide). Add segments shorter than 250 feet to preceding lot. Treat partial segments longer than 250 feet as a lot.
      b. Excluded from the lot are turn lanes, parking lanes, medians, Street Fixtures, crowns of intersecting streets, bridge decks, grades greater than eight (8) percent, and vertical curves less than 1,000 feet radius (including super-elevation transitions).
   2. Profile Deviation: Verify “must grind” bumps and depressions are removed from the lot surface:
      a. Lot is area of total placement. No area is excluded.
      b. Begin traces 50 feet before edge of new pavement and end traces 50 feet after edge of new pavement. Areas (including the 50 feet end traces) exceeding profile deviation tolerance are “must grind” areas.

1.8 **WARRANTY**

A. Joints at Street Fixtures and Concrete Flat Work: If wider than 1/2 inch before end of one year correction period seal joints with asphalt rubber or rubberized asphalt; Section 32 01 17.

PART 2 PRODUCTS

2.1 MATERIALS

A. Asphalt concrete, Section 32 12 05.

B. Superpave, Section 32 12 06.

C. Oil sand concrete, Section 32 12 07.

D. Rubberized asphalt concrete, Section 32 12 08.

E. Tack coat, Section 32 12 13.13.

F. Prime coat, Section 32 12 13.19.

G. Paving geotextile, Section 31 05 19.

H. Paving geogrid, Section 31 05 21.

PART 3 EXECUTION

3.1 CONSTRUCTION EQUIPMENT

A. Paver Machine: Use track equipment when operating on fabrics, geogrids or pavement mats hotter than 180 deg F

B. Compactors: Steel wheel static or vibratory. Use pneumatic tire roller for intermediate rolling only.

C. Profilograph:

1. Capable of producing results required by ASTM E 950 and ASTM E 1274.
2. Set profilograph readings with corresponding project survey stationing, or as a minimum, correlate equipment station 0+00 with a specific project station number. ENGINEER to select.

3.2 PREPARATION

A. General:

1. Locate and preserve utilities, Section 31 23 16. Contact utility companies and other agencies, for dangerous concentration of combustible, flammable, or explosive matter.
2. Lower Street Fixtures if paving machine is not capable of passing over the fixtures.
3. Remove vegetation from cracks, edges and joints. Sweep surface clean. Blow cracks clean. Remove leaves.
4. Fill cracks and fix potholes, Section 32 01 17.
5. Stabilize concrete subgrade slabs.

C. Traffic Control:

1. Implement the notification and traffic control plan requirements. Do not proceed without certified flaggers.

2. Apply temporary lane marking tape or paint after layout has been verified with ENGINEER.

C. Aggregate Base Course:

1. Verify base course is placed to grade, compacted and dampened.
2. If indicated, follow Section 31 31 19 requirements for herbicide treatment or Section 32 12 13.19 for prime coat application.

3.3 PROTECTION

A. Trees, Plants, Ground Cover:

1. Protect trees, plants and other ground cover from damage.
2. Prune trees to allow equipment passage underneath, Section 32 01 93. Repair tree damage at no additional cost to OWNER.

B. Protect all structures, including curb, gutter, sidewalks, guard rails and guide posts from physical damage. Remove spatter, over-coat, or mar.

C. Do not discharge bituminous materials into borrow pits or gutters.

D. Protect hot pavement from traffic until cool enough not to become marred.

E. Remove saw-cut dust immediately. Protect neighborhood, storm drains and down-stream fish habitat.

3.4 TEMPORARY SURFACING

A. Place, roll, maintain, remove and dispose of temporary surfaces.

B. In sidewalk areas construct temporary pavements at least 1 inch thick and in all other areas at least two (2) inches thick. At major intersections and other critical locations a greater thickness may be required.

3.5 LINE AND GRADE CONTROL

A. Provide necessary survey stakes for horizontal and vertical control.

B. Furnish, place, and maintain supports, wire devices, and materials as required to provide continuous line and grade reference controls for placing pavement, matching existing pavement surfaces, etc.

3.6 PLACE ROADWAY PAVING FABRIC

A. Section 31 05 19.

3.7 PAVEMENT PLACEMENT

A. General:

1. Provide continuous forward paver movement so temperature 10 feet behind paver is as follows:
   a. Warm Mix Placement: 200 deg F minimum.

b. Hot Mix Placement:

Table 3 – Minimum Pavement Temperature in Degrees F.

Air Temperature Deg F.	Compacted Mat Thickness					
	3/4"	1"	1-1/2"	2"	3"	4"+
45 – 50	–	–	–	–	280	265
50 - 59	–	–	–	280	270	255
60 - 69	–	–	285	275	265	250
70 - 79	285	285	280	270	265	250
80 - 89	280	275	270	265	260	250
90 +	275	270	265	260	250	250

2. Do not leave unsafe butt joints if paving operation stops.
3. Barricade or eliminate fall off edges.

B. Overlays or Subsequent Lifts:

1. Allow new base pavement or new inlay pavement to cure (harden) before placing overlays.
2. Apply tack coat per Section 32 12 13.13 if inlay or sub-base Pavement surface is dirty or older than 24 hours.

C. Irregular Areas: Handwork is acceptable if specified grade, slope, compaction and smoothness are achieved.

D. Compaction:

1. Test asphalt concrete placement until a compaction patern is acceptable to CONTRACTOR. Continue random quality control testing.
2. Do not over compact or under compact.
3. Complete compaction before the following temperature are reached:
   a. 180 deg F for hot mixes.
   b. 140 deg F for warm mixes.

E. Joints:

1. Construct joints to have same texture, density and smoothness as other sections of new pavement course.
2. Clean contact surfaces and apply tack coat. Ensure continuous bond between old and new pavements, or between successive day's work.
3. Offset longitudinal joints a minimum of 12 inches in succeeding courses and at least six (6) feet transversely to avoid a vertical joint through more than one course. In the top course restrict longitudinal joint to 1 foot either side of lane lines.
4. Prevent traffic, including construction traffic, from crossing vertical edges. Apply tack coat to vertical edges before making another pass with paver if mix has cooled to 90 deg F

3.8 TOLERANCES

A. Compaction: Target is 94 percent of ASTM D 2041 (Rice density) plus or minus two (2) percent.

B. Lift Thickness:

Table 4 – Lift Thickness Tolerance		
Mix Design Method	**Minimum**	**Maximum**
Marshall	2 times maximum aggregate size	Not more than limits established by manufacturer of compactor equipment
Performance Grade (Superpave)	4 times nominal aggregate size	
NOTES (a) Thickness is measured after compaction.		

C. Longitudinal Grade: 1/8 inch in 10 feet parallel to centerline.

D. Cross Slope: 1/4 inch in 10 feet perpendicular to crown line except at cross section grade breaks.

E. Roughness:

Table 5 – Roughness Tolerance							
Speed Mph	**Traffic Class**		**Profile Roughness Index (PRI), Inches / Mile**				**Profile Deviation Inches/25 feet Maximum**
	AC	**Superpave**	**IRI**		**PI**		
			Min	**Max**	**Min**	**Max**	
0 to 30	I or II	0 - 0.3	–	–	–	–	0.4
	III or IV	0.3 to 3.0	129	177	46	66	0.4
31 to 45	I or II	0.3 to 3.0	90	155	35	50	0.4
	III or IV	3.0 to 30	70	90	21	35	0.4
45 +	All Classes	30 or More	–	70	–	21	0.3
NOTES (a) IRI (International Roughness Index), ASTM E 950. Use a 1/4 car. (b) PI (Profile Index), ASTM E 1274. Use a zero blanking band. (c) Profile deviation applies to bump and depression measurements. (d) As a minimum, trace right wheel path in direction of travel (e) AC traffic class is defined in Section 32 12 05. Superpave traffic class is defined in Section 32 12 06.							

3.9 REPAIR

A. All expenses are at no additional cost to OWNER.

B. Corrective Action for Profile Deviations ("Must Grinds"): Grinding is acceptable, Section 32 01 26. Apply Section 32 12 03 cationic or anionic emulsion and sand friction blotter over grind areas.

C. Corrective Action for Profile Roughness Index: Grinding is acceptable. Skin patch for depressions is NOT acceptable. Raise depressions by milling and inlay. Re-profile corrected segments to verify index meets tolerance. Apply a Section 32 12 03 cationic or anionic emulsion and sand friction blotter over grind areas.

D. If depressions cannot be corrected by grinding, do a mill and inlay or a remove and replace repair. **A skin patch with feather edges is not acceptable**.

E. When thickness is deficient, place additional material over deficient areas. DO NOT skin patch. Mill for inlay if necessary.

F. Defective Joints, Seams, Edges: Repair.

G. Unacceptable Paving: Remove and replace.

3.10 **OPENING TO TRAFFIC**

A. Temperature of asphalt surface not more than 180 deg F

END OF SECTION

SECTION 32 13 13
CONCRETE PAVING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Place portland cement concrete in base course, surface course, overlay, or inlay.

B. This specification does not apply to concrete flat work.

1.2 REFERENCES

A. **ACI Standards**:

305 Hot Weather Concreting.

306 Cold Weather Concreting.

318 Building Code Requirements for Reinforced Concrete.

B. **APWA (Utah Chapter) Standards**:

Plan 261 Concrete pavement joints.

C. **ASTM Standards**:

A 307 Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.

C 39 Compressive Strength of Cylindrical Concrete Specimens.

C 78 Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading).

C 94 Ready-Mixed Concrete.

C 174 Measuring Thickness of Concrete Elements Using Drilled Concrete Cores.

C 231 Air Content of Freshly Mixed Concrete by the Pressure Method.

C 1315 Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.

D 3665 Random Sampling of Construction Materials.

D 5249 Backer Material for Use with Cold- and Hot-Applied Joint Sealants in Portland-Cement and Asphalt Joints.

E 950 Measuring the Longitudinal Profile of Traveled Surfaces with an Accelerometer Established Inertial Profiling Reference.

E 1274 Measuring Pavement Roughness Using a Profilograph.

D. **DOT Standards**:

1. Publication No. HIF-07-004: Integrated Materials and Construction Practices for Concrete Pavement.

1.3 SUBMITTALS

A. **Before delivery**: Submit 48 hours before delivery:

1. Traffic control plan, Section 01 55 26.
2. Joint layout plan.
3. Concrete placement plan. Identify items such as but not limited to grade control system, placement start and stop timing, hydration control during cold conditions (ACI 306), hot and windy conditions (ACI 305), timing for evaporation retarder application, timing for curing agent application, floating restrictions, concrete saw-cut timing, header joints.
4. Curing plan. Describe method to prevent excessive concrete temperatures and water evaporation that could impair strength or serviceability of concrete. Refer to ACI 305.
5. Evaporation Retarder Data Sheet. Identify product components, application, and manufacturer's recommendations.
6. Proof of finisher's ACI certification.
7. Make and model name of paving machine, grade trimmer, and gang drill mechanism.
8. Pre-approved concrete mix design or supplier's mix number, Section 03 30 04.
9. Certification of profilograph calibration and profilograph operator.
10. Manufacturer's recommended installation procedures for joint sealing material which, when accepted by ENGINEER, will become the basis for accepting or rejecting actual installation procedures used in the Work.

B. **At Delivery**: Submit batch ticket, Section 03 30 10.

C. **After Placement**: Submit within 48 hours:

1. Profile deviation report.
2. Profile roughness index report.

1.4 **QUALITY ASSURANCE**

A. Do not change concrete supplier until ENGINEER accepts new source and new mix design.

B. Reject product that does not meet requirements of Section 03 30 04.

C. Remove product found defective after installation and install acceptable product at no additional cost to OWNER.

D. Foreman of paving crew has completed at least three (3) projects of similar size and nature.

E. Lead finishing mechanic is ACI certified.

F. Follow state of practice for quality assurance as published in FHWA Publication No. HIF-07-004.

G. If requested, submit a quality control and testing report describing source and field quality assurance activities performed by CONTRACTOR its Suppliers.

1.5 **WEATHER**

A. Hot weather, ACI 305. Set retarding admixture may be used if allowed in mix design. Discontinue placement if ambient air temperature exceeds 100 deg F in the shade.

B. Cold weather, ACI 306 Accelerating admixtures may be used if allowed in mix design. Provide weather protection until 90 percent of design compressive strength is achieved. When removing heat, limit temperature change next to concrete surface to 20 deg F per 12 hours until the concrete surface temperature reaches ambient:

1. Use of admixtures or curing agent will not relax cold weather placement and cure requirements.
2. Do not use chemical additives to prevent freezing.
3 Prevent loss of moisture during protection.

1.6 **NOTICE**

A. Follow Laws and Regulations concerning when and to whom notices are to be given. Send written notice at least three (3) days before start of paving.

B. Indicate paving time and when new surface can be used.

C. Warn of potential vehicle tow away and other construction issues affecting neighborhood.

D. Should work not occur on specified day, send a new notice.

1.7 **ACCEPTANCE**

A. General:

1. Acceptance is by Lot. Lot size is one day production and as listed below.
2. If non-complying material has been installed and no price for the material is specified, apply pay adjustment against cost of work requiring material as part of its installation, Section 01 29 00.
3. Dispute resolution, Section 01 35 10 and Section 03 30 05.
4. Opening a paved surface to traffic does not constitute acceptance.
5. Observation of CONTRACTOR's field quality control testing does not constitute acceptance. Such testing; however, may be used by ENGINEER for acceptance if requirements in Section 01 35 10 are met.

B. Temperature, Slump, Air:

1. Lot size is one (1) random batch.
2. Testing Frequency: Section 03 30 05.
3. Reject non-complying batches until two (2) consecutive batches are compliant then continue in random batch testing for acceptance.

C. Strength: At ENGINEER's discretion, a Lot with deficient sub-lot strength may be accepted if pay is adjusted using one of the following applicable pay factors, or accepted at 50 percent pay if a sub-lot is in Reject.

Table 1 – Strength Pay Factor			
Criteria	**Pay Factor**	**PSI Below 28 day Compressive Strength**	**Lot Size, in Square Yards**
Compression (ASTM C 39)	0.98	1 to 100	500
	0.94	101 to 200	
	0.88	201 to 300	
	0.80	301 to 400	
	Reject	Greater than 400	
Flexure (ASTM C 78)	0.95	1 to 29	750
	0.85	30 to 60	
	Reject	Greater than 60	

1. Strength Dispute Resolution:
   a) CONTRACTOR:
      1) Hire an Independent Testing Agency, Section 01 45 00.
      2) Follow Section 03 30 05 requirements.
      3) Conduct testing at no additional cost to OWNER. Retesting must be completed within 40 calendar days after placement.
   b) ENGINEER:
      1) Accept lot at full pay if average strength of three (3) cores from the defective lot is greater than or equal to 85 percent of compressive strength (f_c'), and if no single strength retest is less than 75 percent of f_c'.
      2) Use original cylinder compressive strengths for pay factor determination if any of above criteria are not met.

D. Placement: Section 03 30 10.
   1. Verify grade, cross slope, finish and dimensions.
   2. No standing water in curb and gutter.
   3. Curing membrane applied at twice coverage rate recommended by curing membrane Supplier.

E. Thickness: A Lot is acceptable if test deficiencies are within pay factor 1.00 limits. At ENGINEER's discretion, a lot with greater sub-lot deficiencies may be accepted if pay is adjusted using one of the following applicable pay factors, or accepted at 50 percent pay if a sub-lot is in Reject.

Table 2 – Thickness Pay Factor		
Pay Factors	**Deficiency Limits, in Inches**	
	Residential street	**Non-residential street**
1.00	0.00 to 0.25	0 to 1/8
0.90	0.26 to 0.50	1/8 to 1/4
0.75	--	1/4 to 1/2
0.70	0.51 to 0.75	--
0.60	--	1/2 to 3/4
0.50	0.76 to 1.00	--
Reject	Greater than 1.00	Greater than 3/4

1. Lot Size: 1,000 square yards or part thereof.
2 Sampling Protocol: Use ASTM D 3665 to randomly select at least one (1) test location in each lot. Collect two (2) samples at each test location. Samples are full depth. Patch core holes.
3. Testing Protocol: ASTM C 174.
4. Thickness Dispute Resolution:
   a. CONTRACTOR:
      1) Hire an Independent Testing Agency, Section 01 45 00.
      2) Take two (2) additional cores midway between deficient acceptance test locations, and midway between a deficient test location and the next adjacent acceptable test location.
      3) Patch core holes.
      4) Conduct testing at no additional cost to OWNER.
   b. ENGINEER:
      1) Graph deficient areas by plotting new cores and original cores to define deficient areas assuming the following.
         a) The graph represents the thickness of the pavement.
         b) Thicknesses vary linearly along the pavement length from core depth to core depth.
         c) The pavement is a constant depth in the transverse direction.
      2) Pay Factor: The pay factor will be calculated over the Lot's deficient area or over areas extending into adjacent Lots.
      3) Accept lot at full pay if new information shows compliance, or
      4) Accept Lot at pay reduction using new test information, or
      5) Reject Lot.

F. Roughness:
   1. Profile Roughness Index (PRI): Verify bumps and depressions are removed so profile roughness index in each lot meets tolerance:
      a. Lot is 0.1 lane mile (528 feet long one lane wide). Add segments shorter than 250 feet to preceding lot. Treat partial segments longer than 250 feet as a lot.
      b. Excluded from the lot are turn lanes, parking lanes, medians, Street Fixtures, crowns of intersecting streets, bridge decks, grades greater than eight (8) percent, and vertical curves less than 1,000 feet radius (including super-elevation transitions).
   2. Profile Deviation: Verify "must grind" bumps and depressions are removed from the lot surface:
      a. Lot is area of total placement. No area is excluded.
      b. Begin traces 50 feet before edge of new pavement and end traces 50 feet after edge of new pavement. Areas (including the 50 feet end traces) exceeding profile deviation tolerance are "must grind" areas.

PART 2 PRODUCTS

2.1 CONCRETE

A. Compression Design: Class 4000, Section 03 30 04. Slump per mix design.

B. Flexure Design:
   1. Strength: 650 psi, ASTM C 78.
   2. Cement Content: 6.5 bags.
   3. Water cement Ratio: 0.44 maximum by weight (before pozzolan exchange), ACI 318.
   4. Entrained Air: Five (5) to seven (7) percent, ASTM C 231 (pressure).
   5. Slump per accepted mix design.

2.2 EVAPORATION RETARDER

A. Water based spray-on liquid that forms a mono-molecular film over the plastic concrete surface.

2.3 CONCRETE CURING COMPOUND

A. Type II Class A or B (white pigmented) liquid membrane forming compound, ASTM C 1315.

2.4 JOINT MATERIALS

A. Section 32 13 73.

B. Expansion Joint Filler: F1 sheet.

C. Contraction Joint Filler (Backer Rod): Type 1 round, ASTM D 5249.

D. Contraction Joint Sealer: HAS1, HAS4, or CAS6.

2.5 **STEEL REINFORCEMENT**

A. Section 03 20 00.

B. Tie Bar: Grade 60 or higher deformed billet steel bars galvanized or epoxy coated.

C. Dowel Bar: Grade 60 or higher billet steel bar, galvainzed or epoxy coated with plastic expansion cap on one (1) end.

D. Chair and Basket Assemblies: Plastic chairs. Galvanized or epoxy coated grade 60 billet steel bar basket assemblies.

E. Hook Bolts: Galvanized ASTM A 307, grade A steel, nuts and shaft internall and externally threaded.

2.6 **BOND BREAKER**

A. Wax based compound.

2.7 **EPOXY ADHESIVE GROUT**

A. Two component, Section 03 61 00.

2.8 **EVAPORATIVE REDUCER**

A. Water-based mono-molecular polymer liquid at application rates recommended by manufacturer. **DO NOT use as a finishing aid**.

PART 3 EXECUTION

3.1 **CONSTRUCTION EQUIPMENT**

A. **Mixing plant**: ASTM C 94, Option C:

1. Use scales certified by the State of Utah. Do not use volume measurement except for water and liquid admixtures.

2. Mixing time must exceed 80 seconds after adding air entrainment admixture.

B. **Cylinder Storage Device**: A container at the work site that maintains an interior temperature of 60 to 80 deg F. equipped with an automatic seven (7) days temperature recorder, accurate within two (2) degrees and having a permanent recording feature. A 24 hours test run may be required. Cease concrete operation when storage capacity of storage device is reached.

C **Concrete Hauling Vehicle**:

1. Truck mixer: Not allowed if ready mix product can be provided. If allowed:

a. Fill drum <u>no more</u> than 63 percent of the gross drum volume and no less than two (2) cubic yards is occupied.

b. Use drum manufacturer's recommended mixing speed (between 12 – 18 rpm)

c. Driver of vehicle has and follows Supplier's manual of

standard operational procedures.

2. Truck Agitator: Do not fill drum greater than 80 percent of the gross drum volume. Use drum manufacturer's recommended agitating speed (between 2 – 6 rpm).
3. Dump truck. End dump or side dump is acceptable. Air content must be controlled at the mixing plant.

D. **Trimmer**: A self propelled unit to strike off and shape surface of road base material so future placement of concrete pavement meets specified thickness. The trimmer uses the same line and grade control assembly or system that the paving machine uses.

E. **Slip Form Paving Machine**:

1. Capable of providing one pass between crown line and back of curb unless specified otherwise.
2. Self Propelled with two or four tracks
3. Steering and elevation controlled from reference string lines.
4. Paving width up to 50 feet (depending upon model and attachments).
5. Weight 2,000 pounds per foot of paving lane width.
6. Continuous auger, hydraulic plow-pans, or conveyor system to distribute concrete in front of the screed.
7. Variable speed internal vibrators.
8. Capable of consolidating mats up to 15 inches thick.
9. Various finishing attachments.

F. **Fixed Form Paving Machine:**

1. Capable of providing one pass between crown line and lip of gutter.
2. Ride on forms or on self-propelled wheels.
3. Steering and elevation controlled by fixed forms.
4. Various paving width.
5. Weight about 1,000 pounds per foot of paving width.
6. Suspended screw auger to spread concrete in front of screed or roller.
7. Has one or two vibrators that move transversely in front of the screed. May also use fixed vibrators near the form edges.
8. Capable of consolidating amts up to 10 inches thick.

G. **Vibrating Screed**:

1. Capable of providing one pass between crown line and lip of gutter.
2. Various paving width.
3. Elevation controlled by fixed forms or string-line.

H. **Finishing and Texturing Equipment**.

1. Machine float may be attached to paver.
2. Texturing equipment acceptable to ENGINEER.
3. Curing compound application device with a fully atomizing type power spray and a wind protection hood.

I. **Straight Edge**: 10 to 20 feet long hand-operated. Successive straightedge checks should overlap by one-half the length of the straightedge.

J. **Profilograph**:

1. Capable of producing results required by ASTM E 950 or ASTM E 1274.
2. Set profilograph readings with corresponding project survey stationing, or as a minimum, correlate equipment station 0+00 with a specific project station number. ENGINEER to select.

3.2 **PREPARATION**

A. General:

1. Locate and preserve utilities, Section 31 23 16. Contact utility companies and other agencies, for dangerous concentration of combustible, flammable, or explosive matter.
2. Lower Street Fixtures if paving machine is not capable of passing over fixtures.
3. Coat surface of Street Fixtures with oil to prevent bond with concrete pavement.
4. Remove sand, leaves and other objectionable materials before placing paving course.
5. Notify ENGINEER at least 24 hours before commencement of concreting operations.

B. Traffic Control:

1. Implement the notification and traffic control plan requirements, Section 01 55 26. Do not proceed without certified flaggers.
2. Apply temporary lane marking tape or paint after layout has been verified with ENGINEER.

C. Aggregate Base Course:

1. Verify base course is placed to grade, compacted and dampened.
2. If indicated, follow Section 31 31 19 requirements for herbicide treatment or Section 32 12 13.19 for prime coat requirement.

D. Cement Treated or Lean Concrete Base:

1. Aggregate Subgrade: Moisten surface but do not place concrete over standing water.

2. Concrete Subgrade:
   a. Remove loose material from surface of cement treated or lean concrete base course immediately before placing concrete surface course.
   b. Apply a double coat of bond breaker before placing surface concrete.

3.3 PROTECTION

A. Protect placed concrete, Section 03 30 10 and as follows:
   1. Do not allow steel wheel rollers or steel wheel vehicles on the concrete Pavement. Keep traffic and construction equipment off at least 10 days after concrete placement or until 100 percent of the design strength has been achieved and verified by either:
      a) Maturity meter.
      b) Concrete cylinders.
   2. If construction traffic is permitted, keep Pavement clean. Remove surface stains and spillage of materials as they occur.
   3. Remove saw-cut dust immediately. Protect neighborhood, storm drains and down-stream fish habitat.

B. Trees, Plants, Ground Cover:
   1. Protect trees, plants and other ground cover from damage.
   2. Prune trees to allow equipment passage underneath, Section 32 01 93. Repair tree damage at no additional cost to OWNER.

3.4 LINE AND GRADE CONTROL

A. General:
   1. Furnish, place, and maintain forms, supports, wire devices, and materials as required for providing continuous line and grade control.
   2. Use survey staking. Distances between line and grade control points are as follows:
      a. 25 feet maximum on tangent sections.
      b. 10 feet maximum on vertical curve high points and low points, and on horizontal curves from PC to PT points.
   3. Provide additional grade control at high points, low points,
   4. Check line and grade control immediately before paving operation.
   5. Use the same grade control system to control the paver and the grade trimmer.

B. Slip Form Paving. Equip machinery with a control system that automatically controls concrete placement to the specified longitudinal grades and transverse cross slopes.

C. Formed Paving. Section 03 11 00. Keep forms free from warps, bends, kinks, and equal in depth to the specified pavement edge. Tightly join formed sections and stop paving operation if the side forms to not meet or hold the following line and grade:

1. Top of forms not more than 1/4 inch from true grade.
2. Vertical face on longitudinal axis not more than 1/4 inch from true line.

3.5 **REINFORCEMENT PLACEMENT**

A. Section 03 20 00.

B. Use smooth dowel in expansion joints.

C. Interrupt reinforcement placement at expansion joints.

D. Keep load transfer bars and dowels in vertical center of concrete and perpendicular to the joint during concrete placement.

E. Position mats on bar chair supports and properly tie before concrete is poured. Keep mats clean, free from rust, flat, and free of distortions. Straighten bends, kinks, and other irregularities or replace units before concrete placement. Provide at least two (2) inch overlap to adjacent mats.

F. DO NOT place the end of a dowel or tie bar within 18 inches of any joint

3.6 **JOINTS**

A. General:

1. Review joint layout with ENGINEER.
2. See APWA Plan 261 for joint types.
3. Do not allow edge slump when placing tie-bars or by over-working edge of slab.
4. If CONTRACTOR chooses to open the roadway to construction or public traffic before final sawing and sealing, install backer rod in the initial (green) cut to prevent entrance of incompressibles.

B. Contraction Joints (Crack Control Joint):

1. Joint spacing measured in feet not to exceed twice the slab thickness measured in inches or 15 feet maximum.
2. Joint depth = T/3. T is depth of concrete slab in inches.
3. Use of a mechanical control joint-void former in lieu of saw cutting or tooling is acceptable.
4. Make transverse joints align with end at curb and gutter joints.
5. Leave forms in place until paving operations are resumed on the other side of the joint.
6. Keep a minimum of three (3) working power saws on site when concrete operations are underway. Saw all joints before uncontrolled shrinkage cracking takes place. Do not tear or ravel concrete during sawing.

C. Expansion Joints:

1. Joint Filler Type:

a. Place joint filler vertical in position, in straight lines. Secure fillers to formwork or other to prevent movement. When butted together, do not leave voids or gaps between filler units.

b. Set joint fillers full depth if no joint sealant is specified. Recess joint fillers if backer rods and joint sealant are specified.

2. Dowel Bar Type:

a. Provide expansion cap on end of dowel bar.

b. If a deformed bar is used in an expansion joint, provide sleeve for movement.

D. Header Joints (Transverse Construction Joints) in Slip Form Paving: Extend concrete paving placement an addition five (5) feet at the end of a day of work or at an interruption for a bridge, intersection, or leave-out. When hardened, saw cut and remove the five feet to create the header. Install dowels into the hardened concrete and continue concrete placement.

E. Volunteer Crack Joint:

1. If a volunteer crack joint falls within five (5) feet of the location of proposed contraction joint, omit the contraction joint.

2. Rout volunteer crack joints to a depth of 1/4 slab thickness per detail 1 APWA Plan 261. Clean and fill crack joint with backer rod and joint sealant.

3. If a volunteer crack joint develops within two (2) feet of expansion or construction joints, replace panel. Use saw cuts and tie-bars or dowels in cut planes.

F. Joint Sealing: Section 32 13 73.

3.7 PLACEMENT

A. Section 03 30 10.

B. Do not place concrete until concrete sub base and surface course forms have been checked for line and grade. Moisten sub base if required to provide a uniform dampened condition at time of concrete placement. Do not place concrete around manholes or other structures until they are at required finish elevation and cross slope.

C. At the beginning of concrete placement:

1. Test slump and air. If corrections are necessary, placement may proceed after two (2) subsequent and consecutive batches pass testing.

2. Tempering, not allowed unless Section 03 30 10 requirements are followed or mix design makes allowance for water addition.

3. Admixtures (such as for air entrainment) not allowed unless specified elsewhere.

D. **Any delay in excess of 15 minutes from placing to start of finishing operations is cause for stopping placement work**.

E. Prevent segregation of mix. Consolidate concrete along face of forms and adjacent to transverse joints with internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand-spreading and consolidation. Consolidate with care to prevent dislocation of reinforcing, dowels, and joint devices.

F. Do not place concrete in a longitudinal section until test specimens from the adjacent lane have attained a compressive strength of 2,500 psi as determined by maturity meter or cast cylinders.

G. Deposit and spread concrete in a continuous operation between transverse joints. If interrupted for more than 1/2 hour, place a construction joint.

H. Place the concrete to the full width of the pavement in a single construction operation unless indicated otherwise.

3.8 **SCREEDING AND FLOATING**

A. Strike-off , consolidate, and provide a smooth surface by screeding

B. After screeding, test slab for trueness with a straight edge. Distribute concrete as required to remove surface irregularities.

C. Apply an evaporation retarder immediately after screeding (or after floating if floating is required). Apply retarder BEFORE bleed water has vanished. **Do not use the retarder as a finishing aid**.

D. Use floating hand methods only where mechanical floating is not possible. Adjust floating to compact surface and produce uniform texture. Refloat repaired areas to provide a continuous smooth finish.

3.9 **FINISHING**

A. Section 03 35 00.

B. DO NOT use steel finishing equipment (floats, trowels, etc.).

C. **Any delay in excess of 30 minutes for completing the finishing operation is cause for stopping concrete placing to correct difficulties**.

D. Round edges of slabs, gutters, back top edge of curb, and formed joints with an edging tool. Eliminate tool marks.

E. Surface Texture: After floating when excess moisture or surface sheen has disappeared:

1. For speed less than 45 mph: 1/16 inch deep burlap drag, turf drag, or broom.

2. For speeds 45 mph and greater: 1/8 inch deep groove placed 80 degrees to center line and randomly spaced between 3/8 and 1-1/2 inches.

F. Do not remove forms for at least 24 hours after concrete has been placed. After form removal, clean ends of joints and patch any minor honeycombed areas. Remove and replace areas or sections with major defects.

3.10 **CURE**

A. Section 03 39 00.

B. Immediately after floating and texturing as the water sheen of the surface is disappearing, apply curing agent in two directions for total white coverage on all exposed surfaces.

C. Apply agent at twice the rate recommended by the compound manufacturer. Applying curing agent too late (after concrete dampness has disappeared) may cause work rejection by ENGINEER.

D. Eliminate thermal shock of concrete by keeping cure temperature close to ground and air temperature.

3.11 TOLERANCES

A. Longitudinal Grade: 1/8 inch in 10 feet parallel centerline.

B. Cross Slope: 1/4 inch in 10 feet perpendicular to crown line except at cross section grade breaks.

C. Thickness: Not more than 1/4 inch deficient.

D. Roughness.

Table 1 – Roughness Tolerance

Speed mph	Traffic Class	Profile Roughness Index, (PRI) Inches / Mile				Profile Deviation Inches/25 feet Maximum
		IRI		PI		
		Min	Max	Min	Max	
0 to 30	I	–	–	–	–	0.4
	II or III	129	177	46	66	0.4
31 to 45	IV	90	155	35	50	0.4
	V	70	90	21	35	0.4
>45	All Classes	–	70	–	21	0.3

NOTES
(a) IRI (International Roughness Index), ASTM E 950. Use a 1/4 car.
(b) PI (Profile Index), ASTM E 1274. Use a zero blanking band.
(c) As a minimum, trace right wheel path in direction of travel.
(d) Profile deviation applies to bump and depression measurements.
(e) Traffic class is defined as follows.
Class I: Parking lots, driveways, light traffic residential streets, light traffic farm roads.
Class II: Residential streets, rural farm and residential roads.
Class III: Urban minor collector streets, rural minor collector roads.
Class IV: Urban minor arterial, light industrial, rural major collector, and minor arterial highways.
Class V: Urban major arterial, heavy industrial streets.

E. Dowel Bar:

1. Maximum allowable skew is 0.375 inches per 12 inches (3 percent) in the horizontal and vertical planes.
2. Embedment is six (6) inches minimum.
3. Position in slab is center plus or minus 1/2 inch.

3.12 REPAIR

A. General: Section 03 30 10. All expenses are at no additional cost to OWNER.

B. Corrective Action for Profile Deviations ("Must Grinds"): Grinding per Section 32 01 26 is acceptable after concrete cure. Apply a water repelling product, Section 07 19 00 over grind surfaces. If depressions cannot be corrected by grinding, remove and replace.

C. Corrective Action for Profile Roughness Index: Grinding is acceptable. Re-profile corrected segments to verify ride index meets tolerance. Apply a water repelling product, Section 07 19 00 over grind areas.

D. Corrective Action for Cracks: Consider repair options published in guidelines by the American Concrete Pavement Association (ACPA). Do not begin corrective work until ENGINEER agrees with repair option. Drill test cores when necessary to determine magnitude. Fill holes with portland cement concrete bonded to pavement with epoxy adhesive.

3.13 **OPENING TO TRAFFIC**

A. Not less than 3,000 psi compressive or 400 psi flexure strength.

END OF SECTION

SECTION 32 13 73
CONCRETE PAVING JOINT SEALANTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Joints and joint sealants in horizontal concrete sidewalks, curb, gutter and roadway pavement surfaces.

1.2 REFERENCES

A. **ASTM Standards**:

C 920 Elastomeric Joint Sealants.

D 545 Preformed Expansion Joint Fillers for Concrete Construction (Nonextruding and Resilient Types).

D 994 Preformed Expansion Joint Filler for Concrete (Bituminous Type).

D 1190 Concrete Joint Sealer, Hot-Poured Elastic Type.

D 1191 Testing Concrete Joint Sealers.

D 1751 Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).

D 1752 Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.

D 1851 Concrete Joint Sealers, Cold-Application Type.

D 2240 Rubber Property - Durometer Hardness.

D 2628 Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements.

D 3405 Joint Sealants, Hot-Poured, For Concrete and Asphalt Pavements.

D 3406 Joint Sealant, Hot-Applied, Elastomeric-Type, for Portland Cement Concrete Pavements.

D 3407 Testing Joint Sealants, Hot-Poured, For Concrete and Asphalt Pavements.

D 3408 Joint Sealants, Hot-Poured, Elastomeric-Type, for Portland Cement Concrete Pavements.

D 3542 Preformed Polychloroprene Elastomeric Joint Seals for Bridges.

D 3569 Joint Sealant, Hot-Applied, Elastomeric, Jet-Fuel-Resistant-Type for Portland Cement Concrete Pavements.

D 3575 Flexible Cellular Materials Made from Olefin Polymers.

D 3581 Joint Sealant, Hot-Poured, Jet-Fuel-Resistant Type, for Portland Cement Concrete and Tar-Concrete Pavements.

D 3582 Testing Joint Sealant, Hot-Poured, Jet-Fuel-Resistant Type, for Portland Cement Concrete and Tar-Concrete Pavements.

D 3583 Joint Sealant, Hot-Applied, Elastomeric Type, for Portland Cement Concrete Pavements, or Joint Sealant, Hot Applied, Elastomeric, Jet Fuel Resistant Type, for Portland Cement Concrete Pavements.

D 5249 Backer Material for Use with Cold- and Hot-Applied Joint Sealants in Portland-Cement and Asphalt Joints.

D 5893 Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements.

B. **FS Standards**:

SS-S-200 Sealants, Joint, Two Component, Jet-Fuel Resistant, Cold-Applied, for Portland Cement Concrete Pavement.

1.3 **SYSTEM PERFORMANCES**

A. Pavement joints include longitudinal and transverse expansion joints, contraction joints, construction joints, and crack control joints.

B. Provide joint sealants that maintain watertight and airtight continuous seals.

1.4 **SUBMITTALS**

A. Manufacturer's certification that product was manufactured, tested and supplied meeting source quality control requirements specified herein, together with a report of the test results and the date each test was completed.

B. Manufacturer's instruction for joint preparation, type of cleaning and installation.

C. Manufacturer's product data and samples for each joint sealant product required.

D. Safety data sheets.

1.5 **QUALITY ASSURANCE**

A. Installation of joint systems are to follow manufacturer’s published directions.

B. For cold applied joint sealant installation, use installers approved by joint sealant supplier.

C. Obtain joint sealing materials from a single manufacturer for each different product required.

1.6 **DELIVERY, STORAGE, AND HANDLING**

A. Deliver materials to site in original unopened containers or bundles with labels identifying manufacturer, product name and designation, color, expiration period for use, pot life, cure time, and mixing instructions for

multi-component materials.

B. Store and handle materials in compliance with manufacturer's recommendations to prevent deterioration; or damage due to moisture, high or low temperatures, contaminants, or other causes.

PART 2 PRODUCTS

2.1 GENERAL

A. Compatibility: Provide joint fillers, sealant backings, sealants, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

2.2 JOINT VOID - FORMER

A. Plastic with a water stop.

B. 1/4 depth of concrete structural section.

2.3 JOINT FILLER - SHEET TYPE

A. **F-1**: Bituminous (asphalt or tar) mastic, ASTM D 994. Formed and encased between two (2) layers of bituminous saturated felt or two (2) layers of glass-fiber felt.

B. **F-2**: Cane or other cellulosic fiber, ASTM D 1751. Saturated with asphalt.

C. **F-3**: Granulated cork, ASTM D 1751. In an asphalt binder; encased between two (2) layers of asphalt saturated felt or two (2) layers of glass-fiber felt.

D. **F-4**: Sponge rubber fully compressible, ASTM C 1752. With resiliency recovery rate of 90 percent minimum.

E. **F-5**: Cork, ASTM C 1752. Impregnated and bound with asphalt, compressible with resiliency recovery rate of 90 percent if not compressed more than 50 percent of original thickness.

F. **F-6**: Plastic foam (for cold-applied sealants only). Preformed, compressible, resilient, non-waxing, non-extruding strips of flexible, non-gassing plastic foam; non-absorbent to water and gas; 30 pounds per cubic foot density maximum, And of size and shape to control sealant depth and performance.

2.4 JOINT FILLER - BACKER ROD, TAPE, POURED FILL TYPE

A. Backer material, ASTM D 5249 for cold-applied and hot-applied joint sealant in portland cement concrete or asphalt pavements joints:

1. Type 1: Round rods.
2. Type 2: Sheets or strips, laminated or skived.
3. Type 3: Poured fills that completely fills pavement joint.

2.5 JOINT SEALANT - GENERAL

A. Color of exposed joint sealant indicated, or if not, as selected from manufacturer's standard colors.

2.6 JOINT SEALANT – HOT APPLIED

A. **HAS-1**: Asphalt base type, ASTM D 3405.

B. **HAS-2**: Thermoplastic type, ASTM D 3581. Jet-fuel resistant without rubber unless indicated otherwise.

C. **HAS-3**: Elastic type, ASTM D 1190.

D. **HAS-4**: Elastomeric type, ASTM D 3406. One component, for portland cement concrete pavements.

E. **HAS-5**: Elastomeric type, ASTM D 3569. One component, jet-fuel resistant, for portland cement concrete pavements.

2.7 JOINT SEALANT – COLD APPLIED

A. **CAS-1**: Elastomeric type, ASTM C 920. Chemically curing, for vehicular or pedestrian use, and types of construction other than highway and airfield pavements and bridges and joint substrates indicated; Type S or M; Grade P or NS; Class 25; Use T, NT, M and O:

1. Self leveling.
2. Shore A Hardness, ASTM D 2240: 40 plus or minus 5.
3. Final cure: Four (4) days maximum.
4. Service range: -10 to 150 deg F

B. **CAS-2**: Mastic type, ASTM D 1851. Single or multiple component; for joints having a minimum width of 1/2 inch.

C. **CAS-3**: Coal-tar modified urethane, FS SS-S-200. One part, jet fuel resistant; Type H.

D. **CAS-4**: Elastomeric preformed polychloroprene type with lubricant adhesive and indicated movement ratio:

1. For concrete pavement seal, ASTM D 2628.
2. For concrete bridge seals, ASTM D 3542.

E **CAS-5**: Silicone type, ASTM D 5893. Single component, non-sag or self leveling, chemically curing sealant based on polymers of polysiloxane structure intended for use in portland cement concrete pavements.

F. **CAS-6**: Asphalt base meeting ASTM D 3405.

G. **CAS-7**: Olefin polymer, ASTM D 3575 as follows:

1. Tensile elongation 255 percent plus or minus 20 percent, Suffix T.
2. Tensile strength 115 psi minimum, Suffix T
3. Density 2.9 plus or minus three (3) lbs/cubic foot, Suffix W, Method A
4. Water absorption 0.025 lbs/square foot maximum, Suffix L.

2.8 SOURCE QUALITY CONTROL

A. Preformed Expansion Joint Fillers: Non-extruding and resilient types, ASTM D 545.

B. Hot-Applied Joint Sealants:

1. Elastic type used in concrete pavements, bridges, other structures, ASTM D 1191.
2. Bituminous type for hydraulic and asphaltic concrete pavements, ASTM D 3407.
3. Elastomeric type for hydraulic concrete pavement, ASTM D 3408.

C. Jet-Fuel-Resistant Joint Sealant: Hot applied, ASTM D 3582 and ASTM D 3583.

D. Cold-Applied Mastic Joint Sealant: Cold applied, ASTM D 1851.

PART 3 EXECUTION

3.1 PREPARATION

A. Remove oil, grease, wax, form-release-agents, curing compounds, bitumens, laitance and old chalking material by sandblast, or water blast as recommended by manufacturer of sealant. Maximum sand blast angle, 25 degrees plus or minus five (5) degrees.

B. Clean and dry with air blast. Do not contaminate air blast with oils or lubricants.

C. Remove frost and moisture in concrete joint substrates before commencing sealing.

D. Install bond breaker tape where needed or required by manufacturer's recommendations to ensure that elastomeric sealants will perform properly.

3.2 JOINT SEALING

A. General:

1. Install sealants in uniform, continuous ribbons without gaps or air pockets, with complete bonding of joint surfaces on opposite sides.
2. Except as otherwise indicated, fill sealant rabbet flush with surface.
3. Where horizontal joints are between a horizontal surface and vertical surface, fill joint to form a slight cove so that joint will not trap moisture and dirt.

B. Depths: Saw cut joints if necessary to provide the required sealant thickness and depth. Install sealant to depths indicated or, if not indicated, as recommended by sealant manufacturer, but within the following general limitations measured at center (thin) section of bead:

1. For sidewalks, pavements, and similar joints sealed with elastomeric sealants and subject to traffic and other abrasion and indentation exposures, fill joints to a depth equal to 75 percent of joint width, but not more than 5/8 inch deep nor less than 3/8 inch deep.

2. For normal moving joints sealed with elastomeric sealants but not subject to traffic, fill joints to a depth equal to 50 percent of joint width, but not more than 1/2 inch deep nor less than 1/4 inch deep.
3. For joints sealed with non-elastomeric sealants and caulking compounds, fill joints full depth.

C. Spillage: Do not allow poured sealant compound to overflow or spill onto adjoining surfaces or to migrate into voids of adjoining surfaces. Clean adjoining surfaces to eliminate evidence of spillage.

D. Heating: Do not use overheated hot-applied sealants.

E. Edges: Unless indicated otherwise, recess exposed edges of gasket and exposed joint fillers slightly behind adjoining surfaces so compressed units will not protrude from joints.

3.3 CURING AND CLEANING

A. Cure sealants and caulking compounds per manufacturer's instructions and recommendations to obtain high early bond strength, internal cohesive strength and surface durability.

B. Clean off excess sealants or sealant smears adjacent to joints as work progresses. Use methods and cleaning materials approved by manufacturers of joint sealant and of products in which joints occur.

C. Remove protective coating and oil from metals with solvent recommended by the sealant manufacturer.

3.4 PROTECTION

A. Protect joint sealant during and after curing period from contact with contaminating substances or from damage resulting from deterioration or damage at time of substantial completion.

B. If damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealant immediately and reseal joints with new materials to produce joint sealer installations with repaired areas indistinguishable from original work at no additional cost to OWNER.

END OF SECTION

SECTION 32 16 13
DRIVEWAY, SIDEWALK, CURB, GUTTER

PART 1 GENERAL

1.1. **SECTION INCLUDES**

A. Concrete flat work such as waterways, waterway transition structures, sidewalks, curb, gutters, Driveway Approaches, etc.

1.2 **REFERENCES**

A. **APWA (Utah Chapter) Standards**:

Plan 205	Curb and gutter.
Plan 206	Curb and gutter dowel tie-in.
Plan 209	Curbs.
Plan 211	Waterway.
Plan 213	Waterway Transition Structure.
Plan 215	Dip Driveway Approach.
Plan 216	Mountable curb driveway approach.
Plan 221	Flare Driveway Approach.
Plan 225	Open Driveway Approach.
Plan 229	Pipe Driveway Approach.
Plan 231	Concrete Sidewalk.

B. **ASTM Standards**:

A 36	Structural Steel.
C 39	Compressive Strength of Cylindrical Concrete Specimens.
C 172	Sampling Freshly Mixed Concrete.

1.3 **DEFINITIONS**

A. **Driveway**: A paved or unpaved vehicular thoroughfare outside of, but connected to a public road right-of-way or highway right-of-way.

B. **Driveway Approach**: A paved or unpaved vehicular thoroughfare connecting a public road or highway to a Driveway.

1.4 **SUBMITTALS**

A. Traffic control plan, Section 01 55 26.

B. Concrete mix design, Section 03 30 04.

C. Batch ticket, Section 03 30 10.

1.5 QUALITY ASSURANCE

A. If requested, submit a quality control and testing report describing source and field quality assurance activities performed by CONTRACTOR and Suppliers.

1.6 NOTICE

A. Follow Laws and Regulations concerning when and to whom notices are to be given at least two (2) days before work starts.

B. Indicate when concrete work will take place and when driveway approach can be used.

C. Warn of potential vehicle tow away and other construction issues affecting neighborhood.

D. Should work not occur on specified day, send a new notice.

1.7 ACCEPTANCE

A. General:

1. Acceptance is by lot. One lot is one day production.
2. If non-complying material has been installed and no price for the material is specified, apply pay adjustment against cost of work requiring material as part of its installation, Section 01 29 00.
3. Dispute resolution, Section 01 35 10 and Section 03 30 05.

B. Concrete Mix:

1. Testing Frequency: Section 03 30 05. Sample per ASTM C 172.
2. Temperature, Slump, Air: Lot size is 1 random batch. Reject non-complying batches until two (2) consecutive batches are compliant then proceed in random batch testing for acceptance.
3. Strength: Lot size is 50 cubic yards. At ENGINEER's discretion and ASTM C 39, a lot with deficient sub-lot strength may be accepted if pay is adjusted using one of the following applicable pay factors, or accepted at 50 percent pay if a sub-lot is in Reject.

Pay Factor	**PSI Below 28 days Compressive Strength**
0.98	1 to 100
0.94	101 to 200
0.88	201 to 300
0.80	301 to 400
Reject	Greater than 400

C. Placement, Section 03 30 10:

1. Verify line, grade, cross slope, finish and dimensions.
2. No standing water in curb and gutter.
3. Membrane curing compound applied for total coverage at two (2) times manufacturer's recommended rate in two (2) directions after finishing and texturing.

PART 2 PRODUCTS

2.1 MATERIALS

A. Concrete Mix:
   1. Class 4000 cast-in-place, Section 03 30 04.
   2. Slump range per mix design.

B. Reinforcement: Grade 60 ksi galvanized or epoxy coated steel, Section 03 20 00, deformed.

C. Expansion Joint Filler: F1 sheet 1/2 inch thick, Section 32 13 73.

D. Contraction Joint Filler (Backer Rod): Closed cell, Type 1 round, Section 32 13 73.

E. Contraction Joint Sealer: HAS1 or HAS4 hot applied, Section 32 13 73.

F. Curing Compound: Membrane forming compound, Section 03 39 00.

G. Plate Steel: Galvanized Steel, ASTM A 36, Section 05 05 10.

PART 3 EXECUTION

3.1 CONSTRUCTION EQUIPMENT

A. Slip Form Machines:
   1. Placement must produce required cross-section, line, grade, finish, and jointing as specified for formed concrete.
   2. If results are not acceptable, remove and replace work with formed concrete.

3.2 PREPARATION

A. Implement the traffic control plan requirements.

B. Examine surfaces scheduled to receive concrete formwork for defects.

C. Do not start work until defects are corrected.

D. Check slopes on each side of the work to ensure drainage. Failure to check and verify will result in CONTRACTOR repairing any drainage deficiencies at no additional cost to OWNER.

3.3 CONCRETE PLACEMENT

A. Section 03 30 10.

B. Make sure base course is uniformly damp at time of concrete placement.

C. Obtain ENGINEER's review of base course and forms before placing concrete.

D. Do not use methods that segregate the mix.

E. Place concrete so time between end of placement and beginning of finishing is less than 15 minutes.

F. Consolidate concrete with vibrator or other acceptable method. Do not use mechanical vibrators. Prevent dislocation of inserts.

3.4 CONTRACTION JOINTS

A. Section 32 13 73.

B. Geometrics:

1. Tooled Joints (Score Lines):

   a. Depth = T/4. T is the depth of the concrete slab in inches.

   b. Top radius = 1/2 inch.

2. Saw Cut Joints: Saw joints before uncontrolled shrinkage cracking occurs. Do not tear or ravel concrete during sawing.

3. Template Joints: 1/8 to 3/16 inch wide 1/4-depth of slab.

C. Sidewalks.

1. At intervals equal to the width of the sidewalk and transverse to the line of walk.

2. Radial at curbs and walk returns.

3. Place longitudinal joints in walks when width of walk in feet is greater than two (2) times the walk thickness in inches. (e.g. maximum width of a four (4) inch thick walk before placement of a longitudinal contraction joint is eight (8) feet). Make longitudinal joints parallel to, or concentric with, the lines of the walk.

4. In walk returns make at least one (1) radial joint midway between beginning of curb returns (BCR) and end of curb returns (ECR). Match longitudinal and traverse joints with joints in adjacent walks.

D. Curb, Gutter, Waterway:

1. Place joints at intervals not exceeding 12 feet.

2. At curb radius and walk returns make joints radial.

3. Where integral curb and gutter is adjacent to concrete pavement, align joints with pavement joints where practical.

3.5 EXPANSION JOINTS

A. General: Section 32 13 73:

1. 1/2 inch wide full depth filler that is flush with concrete surface. Do not place seal over top of joint filler.

B. Sidewalks:

1. Place expansion joints to separate sidewalk from utility poles, hydrants, manhole frames, buildings and abutting sidewalks.

2. Place expansion joints between sidewalk and back of curb returns and between sidewalk and sidewalk ramps.

3. Do not place expansion joints in sidewalk ramp surfaces.

4. Expansion joints are not required when using slip form method to place concrete except where sidewalk changes direction or where it joins foundation walls or structures.

C. Curb, Gutter, Waterway:

1. Do not place longitudinal joint in drain gutter flow-line.
2. Where drain gutter transitions extend beyond curb return, place expansion joints at ends of drain gutter transition.
3. Place expansion joints at beginning of curb radius (BCR) and at end of curb radius (ECR).

D. Curb and Gutter Dowel Te-in: Follow APWA Plan 206 requirements. Tie-in occurs between new and existing curb and gutter.

E. Slip Form Work: Expansion joints are not required except at BCR or ECR.

F. Driveway Approach: Do not place expansion joints in curb returns.

G. Street Intersection Corner: Place expansion joints at BCR and ECR.

3.6 **FINISH**

A. Section 03 35 00.

B. Round edges exposed to public view to a 1/2 inch radius.

C. Apply broom finish longitudinal to curb and gutter flow-line.

D. Apply broom finish transverse to sidewalk centerline as follows:

1. Fine hair finish where grades are less than six (6) percent.
2. Rough hair finish where grades exceed six (6) percent.

E. Remove form marks or irregularities from finish surfaces.

3.7 **TOLERANCES**

A. Curb, Gutter, Curb and Gutter: APWA Plan 205, 209, 211, 213;

1. Line: Less than 1/2 inch variance in 10 feet and not more than 1 inch from true line at any location.
2. Grade: Not more than 1/4 inch variance in 10 feet. Flood curb and gutter with water after final set has been reached. Remove and replace any area where ponding is found.
3. Standing Water: None allowed.

B. Sidewalk: APWA Plan 231:

1. Cross slope one (1) percent minimum, two (2) percent maximum.
2. Standing Water: None allowed.

C. Driveway Approach: APWA Plan 215, 216, 221, 225, 229.

3.8 CURING

A. Section 03 39 00.

B. Curing compound: Apply at two (2) times manufacturer's recommended rate. Apply total coverage in two (2) directions after texturing.

C. Eliminate thermal shock of concrete by keeping cure temperature even throughout extent and depth of concrete slab.

3.9 PROTECTION AND REPAIRS

A. General: All expenses are at no additional cost to OWNER.

B. Protection: Section 03 30 10:

1. Protect concrete work from deicing chemicals during the 28 days cure period.
2. Immediately after placement, protect concrete from graffiti or other types of mechanical injury.

C. Repair: Section 03 30 10. Consider also guidelines published by the American Concrete Pavement Association (ACPA). Do not begin corrective work until ENGINEER agrees with repair option:

1. Correct all humps or depressions.
2. Standing Water: Remove and replace any area where ponding is found. If necessary, flood construction to determine ponding extent.
3. Restore surfaces damaged by saw cutting, grinding, or removal operations.

END OF SECTION

SECTION 32 17 23
PAVEMENT MARKINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Paints for pavement striping.

B. Words and other markings in paint or plastic film.

C. One-way or two-way prismatic reflectors for pavement marking.

1.2 REFERENCES

A. **AASHTO Standards**:

M 237 Epoxy Resin Adhesive for Bonding Traffic Markers to Hardened Concrete.

M 247 Glass Beads Used in Traffic Paint.

M 248 Ready-Mixed White and Yellow Traffic Paints.

M 249 White and Yellow Reflective Thermoplastic Striping Material (Solid Form).

B. **ASTM Standards**:

D 638 Tensile Properties of Plastics.

E 303 Measuring Surface Frictional Properties Using the British Pendulum Tester.

C. **FS Standards**:

LS-300 Sheeting and Tape, Reflective: Nonexposed Lens.

141 Paint, Varnish, Lacquer and Related Materials, Methods of Inspection, Sampling, and Testing.

370 Instrumental Photometric Measurements of Retroflective Materials and Retroreflective Devices.

D. **DOT Standards**:

Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD).

1.3 SUBMITTALS

A. Primer specifications to be used for tape applications.

B. Manufacturer's affidavit certifying paint products meet or exceed material requirements of this section.

C. Sample of prismatic reflector to be used along with manufacturer's statement of the reflector's minimum reflective area and specific intensity at the 0.2 degree observation angle.

D. Manufacturer's recommendation for type of epoxy adhesive to be used when installing prismatic reflectors and markers.

E. Samples of each thermoplastic or preformed plastic pavement markings along with a statement of how the materials will be applied.

PART 2 PRODUCTS

2.1 ALKYD RESIN PAINT

A. White or yellow Type F (Fast dry) ready-mixed, AASHTO M 248.

2.2 THERMOPLASTIC PAINT

A. White or yellow, AASHTO M 249.

2.3 GLASS BEADS

A. Type 1, AASHTO M 247.

2.4 REFLECTIVE TAPE

A. Type II white or yellow with a Class 1 (pressure-sensitive) adhesive, FS L-S-300.

2.5 PREFORMED PLASTIC FILM MATERIALS

A. Film: A retroflective pliant polymer with white or yellow pigments selected and blended to conform to standard highway colors throughout the expected life of the film and glass beads distributed throughout its base cross-sectional area, with a reflective layer of beads bonded to the top surface and composed of the following materials:

Materials	Minimum Percent By Weight
Resin and Plasiticizers	20
Pigments and Extenders	30
Graded Glass Beads	33

1. Type 1: Subjected to high traffic volume and severe wear conditions such as repeated shear action from crossover, encroachment on edge and channelization lines, and stop, start, or turn movements.
   a. Class 1: Without precoated adhesive, for application with epoxy cement.
   b. Class 2: With precoated pressure sensitive adhesive.
2. Type 2: Subjected to lower traffic volumes and less severe wear action such as most highway edge lines, markings on rural highways, lane lines in well-channelized areas and transverse and word or symbols subjected primarily to free rolling traffic:
   a. Class 1: Without precoated adhesive, for application with epoxy cement.
   b. Class 2: With precoated pressure sensitive adhesive

B. Tensile Strength: Sample 6 x 1 x 0.06 inches at a temperature between 70 deg F and 80 deg F using a jaw speed of 10 inches to 12 inches per

minute tested per ASTM D 638 requirements:

1. Type 1: 150 pounds per square inch of cross-section.
2. Type 2: 40 pounds per square inch of cross-section.

C. Elongation: 75 percent minimum at break when tested per ASTM D 638 using a sample 6 x 1 x 0.06 inches at a jaw speed of 10 inches to 12 inches per minute.

D. Skid Resistance: Initial minimum skid resistance values are 35 BPN as measured by the British portable skid test, ASTM E 303 requirements.

E. Reflectance: Minimum reflectance values at 0.2 degrees and 0.5 degrees observation angles and 86.0 degrees entrance angle, FS 370:

Film Type	**Observation Angles**			
	White		**Yellow**	
	0.2°	**0.5°**	**0.2°**	**0.5°**
Type 1: SL (mcd/sf/fc)	550	380	410	250
Type 2: SL (mcd/sf/fc)	960	760	680	510

1. The photometric quantity is measured in specific luminance (SL), and expressed as millicandelas per square foot per footcandle (mcd/sf/fc).
2. Use a test distance 50 feet and a sample size of 2 x 2.5 feet.
3. Use an angular aperture of both the photoreceptor and light projector of six (6) minutes of arc.
4. Reference center is geometric center of sample, and reference axis is taken perpendicular to the test sample.

F. Film Reflectivity Retention: Not more than 15 percent of the beads lost due to pop-out and the predominate mode of failure is "wear down" of the beads, when subjected to 200 cycles of a Taber Abraser Simulation test using an H-18 wheel and 125 gram load.

G. Thickness: 0.06 inch without adhesive.

H. Effective Performance Life: The film, when applied according to the recommendations of the manufacturer, will provide a neat, durable marking that will not flow or distort due to temperature if the pavement surface remains stable. Although reflectivity is apply wear, the pliant polymer will provide a cushioned, resilient substrate that reduces bead crushing and loss. Use a film that shows no appreciable fading, lifting, or shrinkage throughout the useful life of the marking, and shows no significant tearing, roll back, or other signs of poor adhesion.

I. Abrasion Resistance: Use a material that when tested will not wear through to the conformable backing surface in less than 5,000 cycles when tested per FS 141, Method 6192, using a CS-17 wheel and a 1,000 gram load.

J. Acid Resistance: Use a material that will show resistance to etching, hazing, or delamination of bead surface after exposure to a 1 percent solution of sulfuric acid.

2.6 PRISMATIC REFLECTORS

A. Unless indicated otherwise, provide single lens snowplow resistant reflectors of the color indicated:

1. With a cast iron housing and acrylic prismatic reflector.
2. With an overall size not less than nine (9) inches long, five (5) inches wide, and 1-3/4 inch thick with a 7/16 inch maximum projection above the roadway.
3. With a minimum reflective area of 1.6 square inches per face.

B. Reflector Specific Intensity:

	Intensity at 0.2 Degree Observation Angle	
Color	**0 Degree Entrance Angle**	**20 Degree Entrance Angle**
White	3.	1.2
Yellow	1.8	0.72

2.7 EPOXY ADHESIVE

A. Epoxy: Provide a minimum adhesion value of 1.1 pounds per inch width, AASHTO M 237.

PART 3 EXECUTION

3.1 CONSTRUCTION EQUIPMENT

A. Use equipment manufactured for pavement marking. Use workers experienced in operating such equipment.

B. Use equipment capable of applying a strip, or strips with a width tolerance of plus or minus 1/4 inch. Equip machine with an automatic skip control giving a 10 feet long marked segment and a 30 feet long gap within a linear tolerance of six (6) inches over that cycle.

C. If applying glass beads, locate bead applicator directly behind and synchronized with marking applicator.

D. For thermoplastic paint materials, use equipment that is designed to agitate the paint to prevent scorching, discoloration, or excessive high temperatures.

3.2 PREPARATION

A. Broom or flush the surface to remove dirt, loose stones, or other foreign material.

B. Mark roadway between control points established by ENGINEER. ENGINEER will establish points on tangent at least every 100 feet and at 25 feet long intervals on curves. Maintain the line within 1 inch of the established control points. ENGINEER may also designate other pavement striping locations such as stop bars, crosswalks, zebra striping, etc.

C. Markings that adhere to asphalt concrete or Portland cement concrete by

either a pressure sensitive precoated adhesive or an epoxy cement shall mold to the pavement contours by traffic action at normal pavement temperatures and shall be ready for traffic immediately after application.

D. Begin pavement painting and marking operations not later than 24 hours after receipt of written order by ENGINEER.

E. Apply striping and markings per MUTCD requirements.

F. Apply all materials in accordance with manufacturer's and ENGINEER's directions.

3.3 **APPLICATION**

A. Apply pavement paintings and markings only when pavement surface is dry and air temperature is above 40 deg F during daylight hours.

B. Do not apply paints and markings when rain is anticipated within 12 hours.

3.4 **ALKYD RESIN PAINT STRIPING**

A. Adjust pavement striping machine to apply paint at rate recommended by paint manufacturer.

B. Glass Bead Application Rate: 5.9 to 6.1 pounds per gallon of paint.

C. Protect the markings until dry by placing approved guarding or warning device wherever necessary. Remove any markings not authorized or smeared or otherwise damaged, or correct as approved by ENGINEER.

3.5 **THERMOPLASTIC PAINT STRIPING**

A. Clean off dirt, glaze, and grease before prestriping.

B. Prestripe the application area with a binder material that will form, when sprayed, a continuous film over pavement surface, and will dry rapidly and mechanically adhere to pavement surface. Install material in varying widths if indicated.

C. Extrude thermoplastic material at a temperature of 412 plus or minus 12 deg F from approved equipment to produce a line 1/8 inch to 3/16 inch thick, continuous and uniform in shape, and have clean and sharp dimensions.

D. Do not use material that produces fumes that are toxic, obnoxious, or injurious to persons or property.

E. Apply so finished lines have well-defined edges free of waviness.

F. Glass Beads Application Rate: Six (6) pounds of glass beads to every 100 square feet of marking.

3.6 **TAPE STRIPING**

A. Apply pavement marking tape as indicated or directed. ENGINEER will establish control points.

B. Apply tape only on surfaces that are dry and free of oils, grease, dust and dirt, and primed at the rate of approximately 1 quart per 60 feet with an approved primer material.

C. Maintain the line on established control points. Apply intermittent pavement marking tape 24 inches long, spaced approximately 100 feet

on tangents, and approximately 25 feet on curves unless otherwise directed. The ENGINEER will designate other pavement striping locations such as stop bars, crosswalks, zebra striping, etc.

D. Press down tape immediately after application until it adheres and conforms to pavement surface.

E. Completely remove all tape on sections where tape conflicts with revised traffic lanes before opening new lanes to traffic.

3.7 PAVEMENT MARKING FILMS

A. Use pavement marking films that are capable of being applied to new, dense, and open-graded asphalt concrete wearing courses during paving operation in accordance manufacturer's instructions, and that are capable of conforming to pavement contours through the action of traffic at normal pavement temperatures.

B. Use a pavement marking film that is capable of use for patching worn areas of the same type film.

C. Apply before traffic is allowed on freshly paved surface.

D. Unless indicated otherwise, provide Type C, Class II, polymer film markings in specified widths and shapes. Provide and layout words and marking symbol configurations per MUTCD requirements and as indicated.

E. When indicated, inlay markings in fresh asphalt surface by a compaction roller during the paving operation.

F. Apply all markings in accordance with manufacturer's recommendations.

3.8 PRISMATIC REFLECTOR INSTALLATION

A. Install reflectors by cutting pavement and partially filling cut area with epoxy adhesive. Place reflector housing in the adhesive and apply pressure to properly seat. Allow epoxy to completely set before allowing traffic on markers.

B. Install marker so that housing edges are flush with pavement and so that the angle formed by the longitudinal axis of the marker and the adjacent pavement stripe does not exceed five (5) degrees.

3.9 WORDS, SYMBOLS AND OTHER MARKINGS

A. Wet sandblast existing or temporary pavement markings that may be confusing. Removal of markings by high-pressure water may be used if approved by ENGINEER.

B. Apply word markings, letters, numerals and symbols with indicated stencils and templates. In the absence of such information all stencils and templates shall be identical to those currently used by OWNER.

3.10 TEMPORARY PAVEMENT MARKINGS

A. Renew when stripes and markings have lost 50 percent of their original visual effectiveness.

END OF SECTION

SECTION 32 31 13
CHAIN LINK FENCES AND GATES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Chain link fabric, posts, braces, anchorage, gates, miscellaneous hardware and appurtenances.

1.2 REFERENCES

A. **ASTM Standards**:

A 53	Pipe, Steel, Black and Hot- Dipped, Zinc-Coated, Welded and Seamless.
A 121	Zinc Coated (Galvanized) Steel Barbed Wire.
A 392	Zinc Coated Steel Chain-Link Fence Fabric.
A 491	Aluminum Coated Steel Chain-Link Fence Fabric.
A 585	Aluminum Coated Steel Barbed Wire.
A 641	Zinc Coated (Galvanized) Carbon Steel Wire.
F 567	Installation of Chain-Link Fence.
F 573	Residential Zinc Coated Steel Chain-Link Fence Fabric.
F 626	Fence Fittings.
F 654	Residential Chain-Link Fence Gates.
F 668	Poly(Vinyl Chloride) (PVC) Coated Steel Chain-Link Fence Fabric.
F 1043	Strength and Protective Coatings on Steel Industrial Chain Link Fence and Framework.

B. **CLFMI Standards**:

Manual for Chain Link Fence Installation.

1.3 SUBMITTALS

A. Drawings: Indicate plan layout, grid, size and spacing of components, accessories, fittings, anchorage, and post section.

B. Data: Submit manufacturer's installation instructions and procedures, including details of fence and gate installation.

C. Submit sample of fence fabric and typical accessories.

PART 2 PRODUCTS

2.1 **GENERAL**

A. Galvanizing: Class 3, ASTM A 121.

B. Aluminizing: Class 2, ASTM A 585.

C. Polyvinyl Chloride (PVC): For PVC coated materials, paint all posts, fittings, hardware and accessories to match PVC color.

D. Steel Post: Schedule 40, ASTM A 53.

E. Concrete: Class 3000 minimum cast-in-place, Section 03 30 04.

2.2 **CHAIN LINK FABRIC**

A. Steel wire fabric, 11 gage for all fences less than 60 inches in height and nine (9) gage for fences over 60 inches coated as follows:

1. Zinc coating, ASTM A 392.
2. Aluminum coating, ASTM A 491.
3. Polyvinyl chloride coating, ASTM F 668. The fabric shall be hot dipped galvanized steel wire complying with ASTM A 392 and coated with a continuous PVC bonding process (minimum 15 mil thickness). Color of PVC coating as indicated and applied free of voids, cracks, tears and to have a smooth and lustrous surface.

B. For residential fabric, provide zinc coated fabric, ASTM F 573.

C. Unless indicated otherwise use chain link fabric that has approximately two (2) inches square mesh and coated after fabrication.

D. Knuckle finish top edge and twist and barb bottom edge on fabric less than 60 inches wide. For wider fabric, twist and barb finish on both edges. Provide fabric with barbing done by cutting the wire on bias.

E. If indicated, insert slats in fabric.

2.3 **BARBED WIRE**

A. Two strand, 12-1/2 gage wire with 14 gage, four (4) point round barbs spaced approximately five (5) inches on center.

2.4 **TENSION WIRES AND FABRIC TIES**

A. Tension Wires: Seven (7) gage galvanized coil spring steel wire, ASTM A 641.

B. Fabric Fasteners: None (9) gage galvanized or six (6) gage aluminum wire, or approved non-corrosive metal bands, for ties to fasten fabric to posts, rails, and gate frames. Fasten fabric to bottom tension wire spaced 24 inches on center.

2.5 **TRUSS OR TENSION BARS**

A. Galvanized steel rod 3/8 inch diameter for truss or tension bars used in trussing gate frames and line posts adjacent in end, corner, slope, or gate posts. When used in trussing line posts, provide adjustment by means of galvanized turnbuckles or other suitable tightening devices.

B. Tension Bars:

1. Galvanized high carbon steel bars not smaller than 3/16 inch x 3/4 inch for tensions bars to fasten fabric to end and corner posts and gate frames. Provide 1 tension bar for each end post and two (2) for

each corner and pull post per section of fabric.

2. Use tension bar bands made from heavy pressed galvanized steel spaced on 15 inch centers to secure tension bars to posts.

2.6 POSTS, CAPS, RAILS, COUPLINGS

A. Posts, Frames, Stiffeners, Rails: ASTM F 1043.

Table 1 – Posts, Frames, Stiffeners, Rails

Proposed Use	Nominal Type and Size
End, corner, slope and gate posts for single gates 6 feet or less in width and double gate 12 feet or less in width for 1. Fence less than 72 in. high 2. Fence 72 inches or higher	 2" pipe 2-1/2" pipe
Gate posts for single swing gates over 6 feet, but not over 13 feet in width and double swing gates over 12 feet, but not over 26 feet in width or for all slide gates with leaves larger than 6 feet	3-1/2" pipe
Gate posts for single swing gates over 13 feet, but not over 18 feet in width and double swing gates over 26 feet, but not over 36 feet in width	6" pipe
Gate posts for single swing gates over 18 feet in width and double swing gates over 36 feet in width	8" pipe
Frame for gates	1-1/2" pipe
Stiffeners for gates	1-1/4" pipe
Line posts for fence 72 in. or higher	2" pipe
Line posts for fences less than 72 in. high	1-1/2" pipe, or 1-1/8" x 1-5/8" H
Top rail	1-1/4" pipe, or 1-1/2" x 1-1/4" H
Bottom rail	6-gage, coiled spring steel tension wire

B. Posts: Galvanized steel, at indicated length.

C. Caps: Pressed galvanized steel or malleable iron designed to fit securely over post ends forming a weather tight closure. Where top rail is used, provide cap to permit passage of top rail. "H" section posts do not require caps.

D. Top, Intermediate and Bottom Rails: Galvanized steel, in required lengths. Provide joint couplings to connect rails securely. Provide means for attaching top rail securely to each end, corner, line, slope and gate posts.

E. Joint Coupling: Galvanized steel, six (6) inches long minimum for each joint. 1 coupling in five (5) shall have expansion spring. Couplings shall be outside sleeve type with bore of sleeve true to maintain adjacent lengths of rail in alignment.

2.7 **FITTINGS AND HARDWARE**

A. Galvanize fittings and hardware.

B. Rivets: Galvanized steel.

2.8 **SUPPORT OR EXTENSION ARM**

A. Use support or extension arms for barbed wire that are of a type that can be attached to tops of the posts and carry number of wires indicated.

B. Use only support arms that are capable of supporting a 250 pound vertical load at the end of the arm without causing permanent deflection.

C. Single support arms are to be integral with a top post weather cap and have a hole for passage of the top rail when required.

2.9 **GATES**

A. Residential Gates: ASTM F 654.

B. Provide additional horizontal and vertical members to ensure proper gate operation and for attachment of fabric, hardware and accessories.

C. Assemble gate frames and attach hardware by welding or by using fittings and rivets to make rigid connections. Use same fabric as for fence. Install fabric with stretcher bars to gate frame at not more than 15 inch on center.

D. Provide diagonal cross-bracing consisting of 3/8 inch diameter adjustable length truss rods on gates where necessary to prevent frame from sagging or twisting.

2.10 **GATE HARDWARE**

A. Hinges: Pressed steel or malleable iron to suit gate size, non-lift-off type, offset to permit 180 degree gate opening. Provide minimum of one pair of hinges for each leaf.

B. Latch: Forked steel type or plunger-bar steel type to permit operation from either side of gate. Provide locking device and padlock eye as integral part of latch.

C. Keeper: Provide keeper for all vehicle gates which automatically engages the gate leaf and holds it in the open position until manually released.

D. Gate Stops: Mushroom type or flush plate with anchors set in concrete to engage the center drop rod or plunger bar.

E. Sliding Gates: Manufacturer's standard heavy-duty track, ball-bearing hanger sheaves, overhead framing and supports, guides, stays, bracing, steel wheel or rubber wheel, and accessories as required.

PART 3 EXECUTION

3.1 PREPARATION

A. Locate and preserve utilities, Section 31 23 16.

B. Excavation, Section 31 23 16.

C. Review to ASTM F 567 and CLFMI products manual for chain link fence installation.

D. Protect roots and branches of trees and plants to remain.

E. Limit amount of clearing and grading along fence line to permit proper installation.

3.2 LAYOUT OF WORK

A. Accurately locate and stake locations and points necessary for installation of fence and gates.

B. General arrangements and location of fence and gates are indicated. Install except for minor changes required by unforeseen conflicts with work of other trades.

3.3 INSTALLATION OF POSTS

A. Space line posts as follows:

1. Tangent sections to 500 feet radius: 10 feet maximum.
2. 200 feet radius to under 500 feet radius: Eight (8) feet maximum.
3. 100 feet radius to under 200 feet radius: Six (6) feet maximum.
4. Under 100 feet radius: Five (5) feet maximum.

B. Provide pull posts at 500 feet maximum intervals. Changes in line of 30 degrees or more are considered corners.

C. Set all posts to true line and grade in concrete bases or in approved pipe sleeves or sockets. Check for vertical and horizontal alignment.

D. Construct concrete bases for posts at least 10 inches in diameter. Place a minimum of six (6) inches concrete below each post. Depth of post in concrete as follows:

1. Line Posts: 18 inches.
2. End, Pull, Corner and Gate Posts Less Than six (6) inches Diameter: 24 inches
3. Gate Posts: 30 inches.

E. Where posts are required to be set in concrete walls or masonry, set sockets for posts to a depth of at least 18 inches. Use sockets that consist of lengths of 0.048 inch galvanized metal pipe sleeves, with an inside diameter sufficient to allow the posts to fit loosely. Coat inside of socket and outside of posts with bituminous paint. Caulk posts securely in place with lead wool.

3.4 INSTALLATION OF BRACE ASSEMBLIES

A. Attached brace rail from end, pull, corner or gate posts to first ensuing line post. Install braces so posts are plumb when diagonal truss rod is under proper tension.

3.5 INSTALLATION OF RAILS

A. Install rails level and plumb with grade between posts and attached to posts before stretching fabric. Top rails shall form continuous brace from end-to-end of each run of fence.

3.6 INSTALLATION OF FENCE FABRIC

A. Place fence fabric on security side of posts unless otherwise specified. Place fabric approximately 1 inch above the ground. Maintain a straight grade between posts by excavating ground high points. Filling depressions with soil.

B. Stretch fabric taut and securely fasten to posts. Fasten to end, gate, corner, and pull posts. Secure stretcher bars with metal bands spaced at 15 inch intervals. Cut the fabric and fasten each span independently at all pull and corner posts. Fasten to line posts with tie wire, metal bands, or other at 15 inches intervals. Attach the top edge of fabric to the top rail or tension cable at approximately 24 inches intervals. Attach bottom tension wire to fabric with tie wires at 24 inches intervals and secure to end of pull posts with brace bands.

C. Draw barbed wire to assure minimum sag at high temperature and no breakage at low temperature. Connect wires and arms by means of 0.142 gauge galvanized wire stays.

3.7 INSTALLATION OF GATES

A. Install gates plumb, level, and secure for full opening without interference. Install ground-set items in concrete for anchorage as recommended by the fence manufacturer. Adjust hardware for smooth operation.

3.8 REPAIR DAMAGED COATING

A. Grind smooth and wire brush all welds made after galvanizing to remove loose or burned zinc coating, after which neatly coat the areas with 50-50 solder or as otherwise directed by ENGINEER. Make repairs to abraded or otherwise damaged zinc coating in a similar manner. Replace PVC coating.

END OF SECTION

SECTION 32 84 23
UNDERGROUND IRRIGATION SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Underground irrigation system complete with heads, valves, controls, and accessories.

1.2 REFERENCES

A. **ASSE Standards**:

1013 Reduced Pressure Principle Backflow Preventers.

B. **ASTM Standards**:

B 88 Copper Pipe.

B 687 Brass, Copper, and Chromium-Plated Pipe Nipples.

D 1785 Poly (Vinyl Chloride) PVC Plastic Pipe, Schedules 40, 80, and 120.

D 2464 Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings; Schedule 80.

D 2466 Poly (Vinyl Chloride)(PVC), Plastic Pipe Fittings; Schedule 40.

D 2672 Joints for IPS PVC Pipe Using Solvent Cement.

F 656 Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings

C. **NFPA Standards**:

70 National Electric Code.

1.3 DEFINITIONS

A. **Irrigation System**: The arrangement of valves, controls, heads and accessories including lateral and mainline pipe systems.

B. **Mainline Pipe**: Pipe that carries water from point of connection at supply system to the valves.

C. **Lateral Pipe**: Pipe that carries water from the valves to the sprinkler heads or emitters.

1.4 PERFORMANCE REQUIREMENTS

A. Design Pressure: As indicated at the heads.

B. Location of Heads: Design location is approximate. Make adjustments as necessary to avoid plantings and other obstructions.

C. Water Coverage: Turf and other planting areas, 100 percent. Modify layout to obtain coverage and rate of application and to suit manufacturer's standard heads. Do not decrease number of heads indicated unless acceptable to ENGINEER.

D. Pipe Testing Schedule: Section 33 08 00.

E. Flush pipe clean before head placement.

F. Leave system dry if work is Substantially Complete after October 15 unless otherwise acceptable to ENGINEER.

1.5 **SUBMITTALS**

A. Product Data: Manufacturer's technical data and installation instructions.

B. Layout drawings and details illustrating piping layout to water supply location and type and coverage of heads, valves, piping circuits, controls, landscaping features, list of fittings and accessories.

C. Pipeline test report, Section 33 08 00.

D. Operation and Maintenance Data, Section 01 78 23:

1. Submit instructions covering full operation, care, and maintenance of system (and controls) and manufacturers parts catalog.

2. Include year-to-year schedule showing length of time each valve is to be open to provide determined amount of water, drain procedures, cleanout features, etc.

3. Instruct OWNER's maintenance personnel how to operate controller and adjust sprinkler heads

E. Manual Valve Key Operator:

1. Gate valve key.

2. Stop and waste valve key, rigid stee, with"T" handle, standing three (3) feet above ground when used and key end to fit stop and waste valve nut.

PART 2 PRODUCTS

2.1 **PIPE, FITTINGS, OTHER**

A. Mainline Pipe, Lateral Pipe: PVC, Schedule 40 up to 2-1/2 inch diameter, then Class 200 for larger diameters, ASTM D 1785:

1. Smaller than three (3) inches diameter, solvent welded, ASTM D 2672.

2. 3 inches and larger diameter, threaded or mechanical joint.

B. Fittings: Solvent welded or threaded.

C. Sleeves, PVC: Four (4) inch minimum.

D. Riser:

1. Threaded schedule 80 PVC pipe 1/2 inch diameter. Length as required.

2. Half inch barbed swing pipe adapter.

E. Valve Fittings: PVC: Schedule 80 threaded.

F. Copper Pipe: Type K, ASTM B 88.

G. Copper Fittings: Wrought or cast, ASTM B 687.

2.2 **VALVES**

A. Manual Control Valve: Gate type with cast bonze body, resilient integral taper seat, non-rising stem, and fitted for key operation.

B. Manual Drain Valve: Ball type, 3/4 inch bronze body, with replaceable seat disc.

C Automatic Control Valve:

1. Globe type, normally closed, fitted for manual flow adjustment.
2. Totally encapsulated low power replaceable solenoid.
3. High-strength rubber or synthetic rubber diaphragm.
4. Pressure regulating (set for site conditions).

D. Automatic Drain Valve: Designed to open for drainage when line pressure drops below three (3) psi. (NOT for use on mainline pipe.)

2.3 **DRAIN SUMP**

A. Sewer rock or pea gravel, Section 31 05 13.

2.4 **BACKFLOW PREVENTER**

A. Manufacturer's standard, State or OWNER approved, to suit sprinkler system and the following:

1. Reduced Pressure Principle Device: Above ground type, ASSE 1013.
2. Capable of being tested and serviced without removal from pipe line.
3. Body and caps constructed of bronze with wear and corrosion resistant internal parts complete with bronze quarter turn ball valves.
4. When underground irrigation system is designed for liquid fertilizer, provide a reduced pressure backflow prevention device. The drain to daylight must be a minimum of 12 inches below the bottom of the release valve for devices four (4) inches in diameter and smaller, or 12 inches plus the nominal diameter of the devices over four (4) inches in diameter.

2.5 **SPRINKLER HEADS**

A. In General: Heads are placed to provide uniform coverage over entire area of spray indicated at available water pressure.

B. Pop-up Spray Head:

1. Fixed pattern with screw type flow adjustment and stainless steel retraction spring.
2. Pop-up of 4, 6, and 12 inches.
3. Side and bottom inlets on six (6) and 12 inch heads.

C. Rotary Head:
   1. Gear driven, high-impact plastic construction full circle and part circle design.
   2. Built-in check valve.

D. Pop-up Impact Head:
   1. High-impact plastic construction, full circle, part circle, with plastic clapper, and heavy duty steel retraction spring.
   2. Side or bottom inlet.
   3. Built-in check valve required when used with more than three (3) feet of elevation change on the lateral line.
   4. Plastic sprinkler nozzles, interchangeable.

E. Above-ground Impact:
   1. Brass construction with stainless steel clapper.
   2. Mounted above ground with no pop-up features.
   3. Brass sprinker nozzles interchangeable.

2.6 **NOZZLES**

A. Fixed Spray:
   1. Radius pattern and gal/min as required.
   2. Matched precipitation rates.
   3. Stainless steel adjustment screw.
   4. Threaded to match riser.
   5. Pressure regulating: (Required when the psi at the sprinkler does not fall within the range recommended for its use). See manufacturer's specifications.
   6. Filter Screen.

B. Bubbler:
   1. Made of high-impact plastic.
   2. Pressure compensating with adjustable flow and radius as required.
   3. Threaded to match riser.
   4. Attached to fixed riser or pop-up spray.
   5. Filter screen.

2.7 **VALVE BOX**

A. Precast concrete or plastic with adequate hand room to operate small tools and provisions for locking cover to frame.

B. For drain pockets, ASTM size no. 2 gravel (2-1/2 inch) Section 31 05 13.

2.8 **DRIP TUBING**

A. Self cleaning, pressure compensating, polyethylene dripper line.

B. Dripper discharge: 0.6 to 0.9 gal/hr and choice of 12, 18 or 24 inch spacing.

C. Pressure compensation range from eight (8) to 60 psi.

2.9 **LINE FLUSHING VALVE**

A. Automatic cleaning, high impact, 1/2 inch diameter, plastic.

B. Maximum flow rate per flush valve: 15 gal/min.

C. Can be disassembled allowing for winterization blow-out.

2.10 **AIR/VACUUM RELIEF VALVE**

A. Brass body and cap and rated to 200 psi.

B. Temperature resistant silicone disc seat.

2.11 **FILTER**

A. Disk:

1. Corosion resistant thermoplastic, threaded.
2. Multiple disk filter design: 120 mesh.
3. Shut-off valve.
4. Constructed of durable, non-corrosive components and equipped with O-ring seals.

B. "Y":

1. Threaded inlet and outlet.
2. Polyester 0.01 mesh filter screen.
3. Durable, non-corrosive components and equipped with an O-ring seal.
4. Operating flow range of 1 to 15 gal/min with a pressure range of 10 to 150 psi.
5. Easy removable cap and screen.

2.12 **SWING PIPE**

A. Pipe: Polyethylene, flexible, rated for 80 psi.

B. Elbow: Barbed plastic suiting pipe diameter.

2.13 **QUICK COUPLER**

A. Heavy duty brass, one-piece body design.

B. Operating flow range of five (5) to 125 gal/min with a pressure range of 125 psi.

C. Brass key to match valve type and size.

D. Stainless steel spring.

2.14 **JOINT PRIMER AND SOLVENT CEMENT**

A. Refer to ASTM F 656, and ASTM D 2672 requirements.

2.15 VALVE BOX

A. Two inch diameter, Schedule 40 PVC with removable cap, length as required.

2.16 TEFLON TAPE

A. For use on threaded joints. Quality grade, 0.004 inch.

2.17 AUTOMATIC CONTROL SYSTEM

A. General: Furnish low voltage system manufactured expressly for control of automatic circuit valves of underground irrigation systems. Provide unit of capacity to suit number of circuits.

B. Control Enclosure - External Applications: Manufacturer's standard weatherproof enclosure with locking cover, complying with NFPA 70.

C. Control Enclosure - Internal Applications: Manufacturer's standard with locking cover, complying with NFPA 70.

D. Wire:

1. Provide wire for connecting remote control valves to automatic controllers that is Type "UF", 600 volt, stranded or solid copper, single conductor wire with PVC insulation and bearing UL approval for direct underground burial feeder cable. Make all connections with UL approved type seal to make a waterproof connection. Bury wires in the same trench as the pipe where possible.

2. Provide wire with 4/64 inch insulation, minimum covering of ICC-100 compound for positive weatherproofing protection. For wire sizes 14, 12, 10, and 8 use a single conductor solid copper wire, and for sizes 6 and 4 use stranded copper wire. Make control or "hot" wires red and all common or "ground" wires white.

3. Verify wire types and installation procedures conform to local codes.

Table 1 – Valve Wire Sizing Chart

Voltage at Controller	Wire Control Common	Maximum Allowable Length in Feet from Controller to Valves			
		No. of Valves (Solenoids)			
		1	2	3	4
14	14	2765	1309	846	549
14	12	3393	1608	1039	673
14	10	3962	1877	1213	783
12	12	4394	2082	1346	6872
12	10	5397	2557	1652	1071
12	8	6364	3018	1949	1263
10	10	6986	3311	2140	1387

E. Transformer: To convert service voltage to control voltage and in accordance with manufacturer's recommendations.

F. Circuit Control: Each circuit variable from approximately five (5) to 60 minutes. Include switch for manual or automatic operation of each circuit.

G. Timing Device: Adjustable, 24 hours and 14 days clocks to operate any time of day and skip any day in a 14 day period. Allow for manual or semiautomatic operation without disturbing preset mechanical operation.

PART 3 EXECUTION

3.1 EXCAVATION

A. Section 31 23 16.

B. Excavate trenches for sprinkler system pipe to provide 18 inches of cover over Mainline Pipe and 10 inches over Lateral Pipe. Before excavating, establish location of all underground utilities and obstructions.

C. Trench for sprinkler system to ensure proper grades and slopes to drain points.

D. Barricade trenches within the right of way and along pedestrian routes that are left open overnight or that may be a hazard during construction, Section 01 55 26.

3.2 INSTALLATION

A. General: Plans are diagrammatic. Proceed with installation in accordance with the following:

1. Run all Lateral and Mainline pipe as required. Within planting areas avoid conflict with trees. Where trenching is required in proximity to trees which are to remain, do not damage roots.
2. Install stop and waste valves, isolation valves, vacuum breakers, pressure reduction valves, and other equipment required by local authorities according to Laws and Regulations in order to make system complete.
3. Slope Lateral Pipe to drain.
4. After completion of grading, seeding or sodding, and rolling of grass areas, adjust heads to be flush with finished grades.

B. Piping:

1. Assemble all Lateral and Mainline Pipe in accordance with manufacturer's recommendations. Assure positive drainage.
2. At wall penetrations, pack opening around pipe with Section 03 61 00 non-shrink grout. At exterior face, fill perimeter slot with backer rod and sealant. Repair below grade waterproofing and make penetration watertight.
3. Install PVC pipe in dry weather above 40 deg F Allow joint to cure a minimum of eight (8) hours before testing.

C. Sleeves:

1. Install sleeves before concrete work.
2. Under roadway, install PVC sleeve if cover over sleeve exceeds two (2) feet, otherwise use cast iron or ductile iron sleeve.

D. Control Valves:

1. Install remote control valves to manufacturer's recommendation.
2. Use Schedule 80 PVC pipe for nipples on valve header, length as necessary. Install valves one per each plastic valve box and provide 12 inches of expansion loop slack wire at all connections inside valve box.

E. Automatic Drains: Install per manufacturer's recommendations at low point of Lateral Pipes and Mainline Pipes.

F. Manual Drains:

1. Install per manufacturer's recommendations on upstream and downstream side of backflow preventers and at lowest point along Mainline Pipe.
2. Install by teeing down to 3/4 inch drain valve. Provide a drainage sump sized to receive volume of drain water.
3. Make manual drain valves accessible by installing an adjustable pipe sleeve to meet finished grade with locking valve marker lid flush with finish grade.

G. Quick-Coupling Valves: Install using 3/4 inch flexible lateral with galvanized elbow and riser. Locations as indicated.

H. Backflow Preventers:

1. Install assembly complete for sprinkler systems with two (2) drain valves and two (2) shut off valves per local Laws and Regulations, and manufacturer's requirements.
2. In below grade installations install assemblies with drain valves. Provide open box floor with gravel drain sump.

I. Valve Access Boxes:

1. Install over all remote control valves, manual control valves, zone shutoff valves, gate valves or globe valves. Valves to be installed using valve markers will not require access boxes.
2. Install boxes on level subgrade to proper grade and proper drainage.
3. Provide boxes with proper length and size extensions.

J. Automatic Controller:

1. Mount the panel enclosure so adjustments can be conveniently made by the operator.
2. Ground controller per local Laws and Regulations.
3. Make all control wire connections to automatic controllers.
4. Coordinate controller installation with electrical work.

K. Wire and Electrical Work:Use electrical control and ground wire suitable

for sprinkler control cable of size indicated.

L. Sprinkler Heads, Emitters, Bubblers, Small Rotators (less than 10 gallons per minute):
   1. Install with flexible lateral and spiral barbed PVC elbows and riser (length as required).
   2. Install shrub spray heads a minimum of 12 inches above finished grade of plantings.
   3. Install tree bubblers 1/2 inch below crown of tree roots.
   4. Flush Lateral Pipe thoroughly. Remove all foreign materials prior sprinkler head installation.

M. Large Rotator Heads (10 gallons per minute or more): Install pressurized swings joints with O-ring seals.

N. Swivel Hose Elbows: Install brass swivel hose elbows, accurately machined pipe with hose threads and "O" ring seals.

3.3 FLUSHING AND TESTING

A. Mainline Pipe: Section 33 08 00. Test at design pressure:
   1. Flush pipe clean before pressure testing.
   2. Pressure test in sections to expedite backfilling.
   3. Notify ENGINEER 24 hours in advance of pressure testing pipe. Before backfilling and after air pockets have been vented from the lines, pressure test for three consecutive hours. Repair all leaks.

B. Lateral Pipe: Section 33 08 00. Test at design pressure:
   1. Pressure test in sections to expedite backfilling is permitted.
   2. Flush pipe clean before head placement.
   3. Provide one hundred (100) percent precipitation coverage.

3.4 BACKFILLING

A. Section 33 05 20.

B. Backfill above pipe with soil free of rocks over 1 inch diameter, debris, or organic matter. Backfill final four (4) inches with soil of like quality to adjacent areas.

C. Compact Trench backfill thoroughly to prevent settling damage to grades or plant materials. Repair at no additional cost to OWNER.

3.5 SURFACE RESTORATIONS

A. Protect existing landscaping.

B. Restore turf and grass surfaces per Section 32 92 00 or with other ground cover, Section 32 93 13.

C. Replace damaged plants and lawn areas with new to match existing.

3.6 FIELD QUALITY CONTROL

A. Piping may be tested in sections to expedite backfilling.

B. Notify ENGINEER to schedule final inspection after irrigation system is completely installed and fully functional.

C. Make required field adjustment before inspection and changes after inspection as required by OWNER and ENGINEER.

END OF SECTION

SECTION 329110 - LANDSCAPE

PART I - GENERAL

1.1 RELATED DOCUMENTS

A. Site Clearing APWA Section 311100.

1. APWA Section 31 11 00 Site Clearing includes removal of trees, stumps, roots, tree debris, shrubs and other miscellany.

B. Plants Irrigation Section 328210.

1.2 SUMMARY

A. Description

1. The Extent of the landscape work is shown on the drawings and in schedules and includes placement of all plant materials, preparation of landscaped areas, installation of planting soils, landscape fabric, bark mulch, fine mulch, stone mulch, and vegetation guarantee and maintenance for plantings.
2. Subgrade Elevations: Landscape grading shall be restricted to placement of all planting soil and preparation of finish grade. Landscape grading in the restored landscape areas must make smooth transitions to existing grades with no sharp edges, depressions, or mounds.
3. The contractor shall visit the site and study all portions of the contract documents prior to submitting a bid.
4. The repaired landscape areas must blend smoothly into the existing landscape areas that are not removed during construction. The Contractor shall take into consideration existing plant materials and adjacent conditions when installing plants and other materials in repaired landscape areas.
5. As-built Drawings: The Contractor will keep a record of all departures from the contract drawings that occur during construction. These shall be kept on a clean set of prints of the contract drawings. The OWNER’S AUTHORIZED REPRESENTATIVE will review the "as-built drawings" to verify that changes are being recorded as construction occurs.

1.3 QUALITY ASSURANCE

A. The landscape work and irrigation (328210) shall be done by a single firm specializing in landscape construction and qualified in accordance with requirements of these sections.

1.4 SOURCE QUALITY CONTROL

A. General: Ship landscape materials with certificates of inspection as required by governmental authorities. Comply with governing regulations applicable to landscape materials.

B. Do Not Make Substitutions. If specified landscape material is not obtainable, submit in writing, proof of non-availability from a minimum of three suppliers regularly engaged in the growing and sale of the kind and species of plants or other material specified, and a proposal for use of equivalent material for evaluation to be accepted

or not accepted prior to the bid.

C. The source or supplier for all plant materials shall be furnished to the OWNER'S AUTHORIZED REPRESENTATIVE prior to the delivery of any plant materials on site or stored elsewhere.

D. Trees and Shrubs, and other plant materials: Provide trees and shrubs, and other plant materials grown in a recognized nursery in accordance with good horticultural practice. Provide healthy, vigorous stock grown under climatic conditions similar to the locality of the project and free of disease, insects, eggs, larvae, and defects such as knots, sun-scale, injuries, abrasions, or disfigurement.

E. Plant Materials and other landscape items will be evaluated according to compliance with drawings, schedules, and specifications; as well as overall aesthetic quality, grower or supplier reputation, physical inspection, and American Association of Nurseryman Standards (AANS).

F. Sizes: Provide plants of the sizes shown or specified on the plans. Plants of a larger size may be used pending approval by the OWNER'S AUTHORIZED REPRESENTATIVE and if sizes of root balls or containers are increased proportionately.

G. Inspection: All plant materials are to be inspected and approved by the OWNER'S AUTHORIZED REPRESENTATIVE at the time of delivery on site. This approval does not constitute final acceptance of any plant material. All plant materials will be inspected again at time of final inspection and once again at the end of the warranty period. Any plant found to be unacceptable at any of these inspections shall be immediately removed and replaced.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in containers showing weight, analysis and name of manufacturer. Protect materials from deterioration during delivery, and while stored at the site.

1.6 PLANT MATERIALS

A. Trees, Shrubs, and other plants: Do not prune prior to delivery. Do not bend or bind-tie in such a manner as to damage bark, break branches or destroy natural shape. Provide protective covering during delivery.

B. Deliver plants after preparations for planting have been completed and plant immediately. If planting is delayed more than 6 hours after delivery, set plants in shade, protect from weather and mechanical damage, and keep roots moist.

C. Do not remove container-grown stock from container until planting time.

D. Label at least one plant of each variety with a securely attached waterproof tag bearing legible designation of botanical and common name.

1.7 JOB CONDITIONS

A. Examine the subgrade, verify the elevations which should allow for the depths of planting soil required throughout the planted areas, and mulch. Observe the conditions under which work is to be performed, and notify the OWNER'S

AUTHORIZED REPRESENTATIVE of unsatisfactory conditions.

1. Utilities: Determine location of underground utilities and perform work in a manner that will avoid possible damage. Hand excavate, as required, to minimize possibility of damage to underground utilities. The Contractor shall notify Blue Stakes prior to digging. Any damage incurred by the Contractor to be repaired or replaced at no additional expense to the Owner.

B. Proceed with and complete the landscape work as rapidly as portions of the site become available, working within the seasonal limitations for each kind of landscape work required.

C. Planting Schedule: Prepare a proposed planting schedule. Schedule the dates for each type of landscape work during the normal seasons for such work in the area of the site. Once accepted, revise dates only as approved in writing, after documentation of reasons for delays.

1.8 GUARANTEE AND ESTABLISHMENT

A. Guarantee Trees, Shrubs and other plants that are irrigated or hand watered through the specified maintenance and establishment period.

PART II - PRODUCTS

2.1 TOP SOIL

A. See APWA Specification Standard Specification Section 310513 Common Fill.

B. Prior to the installation of any top soil, contractor shall inspect the existing subgrade for compliance to the specifications with regards to grade and cleanliness. Any discrepancy shall be brought to the attention of the OWNER’S AUTHORIZED REPRESENTATIVE for appropriate action.

C. Top soil depths shall be 12 inches minimum in shrub areas using existing topsoil when possible.

D. Utilize whatever existing top soil is available for salvage and reuse, and supplement with imported top soil.

2.2 PLANT MATERIALS

A. Quality: Provide trees, shrubs and other plants that comply with the recommendations and requirements of ANSI Z60.1 "Standard for Nursery Stock" and as further specified. The OWNER’S AUTHORIZED REPRESENTATIVE reserves the right to refuse plant materials that do not meet the quality required for the project.

B. Deciduous Trees: Provide trees of height and caliper listed or shown and with minimum branching configuration recommended by ANSI Z60.1 for type and species required.

C. Provide balled and burlapped (B &B) deciduous trees.

D. Container grown deciduous trees will be acceptable in lieu of balled and burlapped deciduous trees and where specified in plant schedule subject to specified limitations of ANSI Z60.1.

E. Deciduous Shrubs: Provide shrubs of the height and size shown or listed and with not less than the minimum number of canes required by ANSI Z60.1 for the type and height of shrub required.

F. Container Grown Deciduous Shrubs will be acceptable subject to specified limitations of container grown stock.

G. Coniferous Evergreens: Provide unsheared evergreens of the sizes shown or listed. Provide normal quality evergreens with well balanced form complying with minimum requirements for other size relationships to the primary dimension indicated on the Planting Plans.

H. Provide balled and burlapped (B &B) evergreens.

I. Container Grown Evergreens will be acceptable subject to the specified limitations for container grown stock.

J. Groundcovers and Perennial Plants: Provide materials of the species and size indicated and grown according to ANSI requirements.

2.3 MISCELLANEOUS MATERIALS

A. Landscape Fabric: Landscape fabric to be non-woven weed barrier geotextile with elongation less than 50 percent. Basic weight 3.0 oz/sq yd with a water flow rate greater than 40 gal/min/sq ft. Securing pins shall be galvanized steel 0.09 inch diameter, U-shaped with 6 inch legs.

B. Stone Mulch:

1. Submit stone mulch sample for approval by the Contracting Officer.

C. Boulders: Granite or sandstone boulders, to match stone mulch.

1. Large Boulder: ranging in size from 3’ – 4’.
2. Medium Boulder: ranging in size from 2’ – 3’.
3. Boulders excavated during construction may be used if accepted by the Contracting Officer.

PART III - EXECUTION

3.1 COORDINATION

A. The contractor shall coordinate his work with that of other contractors on site, and shall cooperate to the fullest extent to see that the work is completed in a timely and workmanship like manner.

B. Planting Operations: The OWNER’S AUTHORIZED REPRESENTATIVE prior to the digging of any holes must approve the exact locations of all plants. Refer to the drawings for the sizes and preparation of holes. Prepare all holes according to the details on the drawings.

3.2 TREE AND SHRUB PLANTING

A. Set out trees and shrubs in the beds in the location where they are to be planted and

receive approval by Owner's Authorized Representative prior to planting.

B. Prior to planting fill excavated tree pit with water and allow it to percolate out. If, after 24 hours, the water has not percolated out of the pit, notify the OWNER'S AUTHORIZED REPRESENTATIVE. Do not plant until the problem has been corrected.

C. The tree and shrub planting holes should be the same depth as the rootball or as shown in details. Trees must be placed on undisturbed soil at the bottom of the planting hole, or on settled and tamped planting soil. The tree hole depth shall be determined so that the tree may be set at finish grade, using the top of the root ball as a guide.

D. Set tree on soil and remove top 1/3 of burlap. Wire baskets shall be cut, and twine and wrappings shall be cut and removed as backfilling operations are completed.

E. All tree holes shall be backfilled in 12 inch lifts and settled and tamped to minimize any settling of the tree.

F. Upon completion of backfilling operation, thoroughly water the tree to completely settle the soil and fill any voids that may have occurred.

G. The amount of pruning shall be limited to the minimum necessary to remove dead or injured twigs and branches. All cuts, scars and bruises shall be properly treated according to the direction of the OWNER'S AUTHORIZED REPRESENTATIVE. Proper pruning techniques shall be used. Do NOT leave stubs and do NOT cut the leader branch. Improper pruning shall be cause for rejection of the plant material.

H. Mulching: Upon completion of all planting operations, remove all undesirable material from the surface of the planting beds, including all rocks over the size of 1 1/2" diameter; re-establish all watering basins and install the specified mulch in all planting beds.

I. Saucers: Saucer shall be formed at the base and it shall be watered the same day as planting.

3.3 LANDSCAPE FABRIC

A. Place under all Stone Mulch

B. Place fabric as detailed; overlap all seams 6 inches minimum.

3.4 STONE MULCH

A. Complete all required landscape grading, planting, and landscape fabric placement before applying stone mulch.

B. Place stone mulch to a depth of 3 inches.

C. Do not place stone mulch next to tree trunks or shrub bases.

3.5 BOULDERS

A. Excavate boulder locations to ensure boulder to be buried one-third of its height.

B. Install in locations directed by the Owner's Authorized Representative and as detailed.

C. Boulders to be placed in a manner that appears natural, vertical placement to be avoided.

3.6 GUARANTEE, MAINTENANCE, AND ESTABLISHMENT

A. Guarantee Trees, Shrubs and other plants through the specified maintenance and establishment period.

1. Replace any unsatisfactory or dead plantings within 10 days of written notice. Make correction at no additional cost to OWNER.

2. Remove and Replace trees, shrubs or other plant material found to be unacceptable. Replacements shall be made during the growing season and shall comply with all requirements and specifications. Replace plants with the same species and size as originally planted.

B. Contractor will not be held responsible for plants damaged due to acts of nature or vandalism.

C. Begin Maintenance immediately after planting.

1. Maintain plants and lawns by watering, pruning, cultivating and weeding as required for healthy growth. Restore planting saucers. Spray as required to keep plant materials free of insects and disease.
2. The contractor shall instruct the OWNER'S AUTHORIZED REPRESENTATIVE and OWNER'S Authorized Representative as to the watering requirements after establishment.
3. The contractor shall be responsible to monitor the plant material including irrigation practices. The contractor must report to the OWNER'S AUTHORIZED REPRESENTATIVE any evidences of over watering, under watering, or other plant damage after establishment.
4. Place additional bark mulch and fine mulch at the end of the maintenance period to maintain the specified mulch depth.
5. The contractor is responsible for weed control during the maintenance and establishment period.

D. Maintenance and Establishment Period

1. Maintain and Establish landscapes for 1 years from project completion.

3.7 CLEANUP AND PROTECTION

A. During Landscape Work, store materials and equipment where directed. Keep pavements clean and work area in an orderly condition.

B. Protect Landscape Work and materials from damage due to operations by other contractors and trades and trespassers. Maintain protection during installation and maintenance periods. Treat, repair or replace damaged landscape work as directed.

C. The contractor shall keep the site free from accumulation of waste material. At the time of completion, all areas must be swept or washed clean and all rubbish removed to the satisfaction of the OWNER'S AUTHORIZED REPRESENTATIVE.

3.8 INSPECTION AND ACCEPTANCE

A. When the landscape work is completed, including maintenance, the OWNER'S

AUTHORIZED REPRESENTATIVE will, upon request, make an inspection to determine acceptability.

B. Where inspected landscape work does not comply with the requirement, replace rejected work and continue specified maintenance until re-inspected by the OWNER'S AUTHORIZED REPRESENTATIVE and found to be acceptable. Remove rejected plants and materials promptly from the project site.

C. As-built Drawings shall be furnished to the OWNER'S AUTHORIZED REPRESENTATIVE at the time of the Final Inspection before Certificate of Substantial Completion will be issued.

END OF SECTION 329110

DIVISION 33

UTILITIES

SECTION 33 05 06
POLYETHYLENE PIPE

PART 1 GENERAL

1.1. SECTION INCLUDES

A. Polyethylene pipe, couplings, fittings and joint materials.

1.2 REFERENCES

A. **AASHTO Standards**:

M 252 Corrugated Polyethylene Drainage Pipe.

M-294 Corrugated Polyethylene Drainage Pipe 300-1200 mm Diameter.

MP7-97 Corrugated Polyethylene Pipe – 1350 and 1500 mm Diameter.

B. **ASME Standards**:

B1.1 Unified Inch Screw Threads (UN and UNR Thread Form), Supplement.

C. **ASTM Standards**:

A 307 Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.

D 2239 Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Controlled Inside Diameter.

D 2321 Underground Installation of Flexible Thermoplastic Sewer Pipe.

D 2657 Heat Joining of Thermoplastic Pipe and Fittings.

D 2774 Underground Installation of Thermoplastic Pressure Piping.

D 3261 Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.

D 3350 Polyethylene Plastics Pipe and Fittings Materials.

F 477 Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

F 1055 Electofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene Pipe and Tubing.

1.4 DEFINITIONS

A. **Standard Dimension Ratio (SDR):** Average diameter of pipe divided by the minimum wall thickness. The diameter may be either inside or outside measurement depending upon which standard is referenced.

B. **Code Designation**: A rating system by the Plastic Pipe Institute for smooth wall polyethylene pipe materials. The designation PE 3408 designates the type of plastic pipe (PE), the grade (34), and the hydrostatic design stress measured in units of 100 psi (08) at 23 deg C.

PART 2 PRODUCTS

2.1 SMOOTH WALL PIPE SYSTEMS

A. Material: PE 3408 per ASTM D 2239 with a minimum cell classification of 345434C per ASTM D 3350.

B. Pipe: Smooth wall inside and out with an SDR or working pressure rating indicated or accepted by ENGINEER with exterior markings as follows:

1. ASTM Standard Number.
2. Pipe Size.
3. Class and profile number.
4. Production code.
5. Standard dimension ratio.

C. Fittings:

1. Resin same as pipe.
2. Working pressure same or greater than pipe.

D. Joints:

1. Thermally welded butt fusion, ASTM D 3261.
2. Flanged, ASTM D 2657.
3. Ultra high molecular weight electo-fusion tape with a polyethylene coupler meeting ASTM F 1055 requirements.

2.2 CORRUGATED WALL PIPE SYSTEMS

A. Material: Polyethylene, ASTM D 3350 with a cell class as required in AASHTO M 252, AASHTO M 294 or AASHTO MP7-97

B. Pipe: Type S or D unless required otherwise. Corrugations may be either annular or helical.

Type	Description
C	Circular pipe with a corrugated surface inside and out.
CP	Type C pipe with perforations
S	Circular pipe with an outer corrugated wall and a smooth inter wall

SP Type S pipe with perforations

D Circular pipe with a corrugated wall sandwiched between a smooth outerwall and a smooth inner wall.

C. Fittings:

1. Blow molded with cell class 335420C, ASTM D 3350.
2. Rotational molded with cell class 213320C, ASTM D 3350.
3. Shop or field remanufactured of the same material as the pipe

D. Joints:

1. Bell and spigot with gaskets, ASTM F 477. Foam type weather stripping not allowed.
2. Split corrugated couplings with plastic or stainless steel ties and leak resistant neoprene gasket.

2.3 **NUTS AND BOLTS**

A. Carbon steel machined heavy hex heads, Class 2 fit, ASTM A 307; Grade B, threads, ASME B1.1.

PART 3 EXECUTION

3.1 **INSTALLATION**

A. Install pipe per manufactuerer's instructions and the following.

1. Gravity Systems: Section 33 31 00 (sanitary sewer) or Section 33 41 00 (storm drainage systems) and ASTM D 2321.
2. Pressure Systems: Section 33 12 19 (water distribution and transmission) and AWWA C900 or ASTM D 2774.
3. Underground Irrigation Systems: Section 32 84 23, (underground irrigation system) and ASTM D 2855.

B. Provide six (6) mil thick polyethylene sheet and tape wrap on steel materials for protection against corrosion after piping installation.

END OF SECTION

SECTION 33 05 07
POLYVINYL CHLORIDE PIPE

PART 1 GENERAL

1.1. **SECTION INCLUDES**

A. Polyvinyl chloride pipe, couplings, fittings and joint materials.

1.2 **REFERENCES**

A. **ASTM Standards**:

D 1784 Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.

D 2241 Poly (Vinyl Chloride) (PVC) Pressure Rated Pipe (SDR - Series).

D 2321 Underground Installation of Flexible Thermoplastic Sewer Pipe.

D 2412 Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.

D 2564 Solvent Cement for Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings.

D 2729 Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

D 2774 Underground Installation of Thermoplastic Pressure Piping.

D 2855 Making Solvent Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings.

D 3034 Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

D 3139 Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.

D 3212 Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.

F 656 Primers for Use in Solvent Cement Joints of Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings.

F 679 Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.

F 949 Poly(vinyl Chloride) (PVC) Corrugated sewer Pipe with a Smooth Interior and Fittings.

B. **AWWA Standards**:

C110 Ductile-Iron and Gray-Iron Fitting, 3 inches Through 48 inches, for Water and Other Liquids.

C900 Polyvinyl Chloride (PVC) Pressure Pipe, 4 In. Through 12 In., for Water Distribution.

C905 Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In. Through 48 In.

C909 Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe, 4 in. Through 24 In., for Water, Wastewater, and Reclaimed Water Service.

1.3 DEFINITIONS

A. **Standard Dimension Ratio (SDR):** Outside diameter of pipe divided by wall thickness.

PART 2 PRODUCTS

2.1 GRAVITY PIPE SYSTEMS

A. Pipe:

1. Solid smooth wall:
   a. 4 to 15 inch diameter, ASTM D 3034.
   b. 18 to 27 inch diameter, ASTM F 679.
2. Corrugated wall with a smooth interior, 4 to 10 inches diameter, ASTM F 949.

B. Fittings: ASTM D 1784.

C. Stiffness: 50 psi minimum when measured at five (5) percent deflection, ASTM D 2412.

D. Additives and Fillers: Not to exceed 10 parts by weight; 100 parts of resin in the compound.

E. Joints: Bell and spigot with flexible elastomeric seals, ASTM D 3212.

F. Flattening: No visual evidence of splitting, cracking, or breaking when flattened to 60 percent deflection, ASTM D 2412.

2.2 PRESSURE PIPE SYSTEMS

A. Pipe: AWWA C900, C905, or C909 as applicable. Use outside diameters defined by ductile iron pipe sizes. Dimensions, class, SDR, and tolerances per ASTM D 2241.

B. Compounds: Type 1, Grade 1, Class 12454A, ASTM D 1784.

C. Joints:

1. Bell and spigot with flexible elastomeric seals, ASTM D 3139. Use non-toxic lubricant.
2. Solvent weld, ASTM D 2564.

D. Fittings (4 inch and larger): Ductile iron Class 250, ASTM C110.

2.3 **PERFORATED PIPE SYSTEMS**

A. Pipe: Refer to gravity pipe products above.

B. Perforations: ASTM D 2729.

C. Joints: Push-on, solvent weld or other.

2.4 **SOLVENT WELDS**

A. Primer, ASTM F 656.

B. Glue, ASTM D 2564.

PART 3 EXECUTION

3.1 **INSTALLATION**

A. Install pipe per manufactuerer's instructions and the following.

1. Gravity Systems: Section 33 31 00 (sanitary sewer) or Section 33 41 00 (storm drainage systems) and ASTM D 2321.
2. Pressure Systems: Section 33 12 19 (water distribution and transmission) and AWWA C900, C905, C909 or ASTM D 2774.
3. Underground Irrigation Systems: Section 32 84 23, (underground irrigation system) and ASTM D 2855.

END OF SECTION

SECTION 33 05 14
UTILITY GRADE ADJUSTMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Raise, lower, or change slope of Street Fixtures.

B. Install Cover Collars.

C. This specification is NOT APPLICABLE to raising and lowering Street Fixtures that withstand internal pressure.

1.2 DEFINITIONS

A. **Box**: A structure such as a valve box, meter box, monument box, fire hydrant box, electrical pull box, cleanout box or other like structure not intended for human entry.

B. **Cover Collar**: A concrete filled annular space between a Street Fixture frame and the adjacent pavement surface.

C. **Extension Ring**: A concrete or metal ring used to adjust surface elevations and surface cross slopes of Street Fixtures covers. Metal rings are used between metal frames and metal covers or grates. Concrete rings are used below metal frames or in the concrete structure below.

D. **Manhole**: A structure designed to permit human entry and working space inside and to confine and control the flow of pipe-conveyed fluids. These structures are collectively referred to as manholes regardless of composition, design, type or depth.

E. **Street Fixture**: The top of existing structures such as but not limited to Manholes, catch basin, sumps, inlets, valve boxes, meter boxes, monument boxes, and similar structure in a thoroughfare surface.

F. **Vault**: A structure intended for human entry containing electrical or telephone facilities or other like utilities.

PART 2 PRODUCTS

2.1 PAVEMENT

A. Asphalt Concrete: AC-20-DM-1/2, Section 32 12 05.

B. Concrete: Class 4000 cast-in-place, Section 03 30 04.

2.2 GROUT

A. Portland cement grout, Section 03 61 00.

2.3 EXTENSION RINGS

A. Metal: Cast iron, Section 05 56 00.

B. Concrete: Class 4000 cast-in-place, Section 03 30 04.

PART 3 EXECUTION

3.1 PREPARATION

A. Determine condition of existing incidental structure. Any item not reported damaged before construction shall be considered unbroken and must be replaced by CONTRACTOR at no additional cost to OWNER.

B. Provide Invert Cover over pipe in cleanout box to prevent gravel, concrete, or debris from entering pipeline.

C. Unless required otherwise, arrange for utility companies to adjust their own structures.

D. Coordinate all adjustments with requirements of affected utility company.

3.2 ADJUST STRUCTURE TO GRADE

A. Restrict excavation around structure to a minimum.

B. After structure adjustment, backfill void around structure and compact before paving or landscaping.

C. Apply mortar to inside and outside of concrete grade rings.

D. If the cone is cracked during construction, restack the manhole with shorter manhole sections and install a new cone at no additional cost to the OWNER.

3.3 ADJUST COVER IN PAVEMENT SURFACE

A. Method A - Metal extension rings:

1. Use rings that lock together.
2. Set frame at desired elevation and cross-slope.
3. Seal joints between pavement and ring, Section 32 01 17.

B. Method B – Concrete extension rings:

1. Place concrete grade rings under frame or in structure riser shaft.
2. Set frame at desired elevation and cross-slope.
3. Provide 100 percent concrete support under frame. Do not use wood, bricks, concrete fragments, blocks or particles as support.
4. Grout seams between concrete rings and between frame and concrete rings.

C. Method C – Place Concrete:

1. Set frame at desired elevation and cross-slope.
2. Place concrete and provide 100 percent concrete support under frame.

D. Method D – Concrete Deck:
   1. Remove existing concrete deck.
   2. Reset steel rebar.
   3. Set frame to grade, set forms.
   4. Pour concrete. Provide complete concrete support under Street Fixtures.

3.4 INSTALLING COVER COLLAR

A. Open annular space between pavement and Street Fixtures cover. Unless indicated otherwise, make space 12 inches wide.

B. Set concrete collar to 1/4 inch minimum to 1/2 inch maximum below asphalt concrete pavement surface and 1/4 inch below portland cement concrete pavement surface.

C. Trowel finish, Section 03 35 00.

3.5 PAVEMENT SURFACE RESTORATION

A. In new streets or overlays, adjust Street Fixtures cover after asphalt paving is complete.

B. Asphalt pavement restoration, Section 33 05 25.

C. Concrete pavement restoration, Section 33 05 25.

END OF SECTION

SECTION 33 05 20
BACKFILLING TRENCHES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Trench backfill materials.

B. Trench backfilling requirements.

1.2 REFERENCES

A. **ASTM Standards**:

D 698 Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3)).

D 1557 Laboratory Compaction Characteristics of Soil using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3)).

D 2922 Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

D 4832 Preparation and Testing of Soil-Cement Slurry Test Cylinders.

1.3 DEFINITIONS

A. **Bedding**: That surface of the excavation or portion of the Pipe Zone below the pipe.

B. **Pipe Zone**: That zone in a backfilling operation which supports, and surrounds the pipe barrel, and extends to 1 foot above the top of the pipe barrel.

1.4 SUBMITTALS

A. Submit maximum laboratory dry density and optimum laboratory moisture content for:

1. Subgrade material, and
2. Each type of fill to be used.

B. Submit aggregate batch delivery tickets showing name of material source, serial number of ticket, date and truck number, name of Supplier, job name and location, volume or weight. And aggregate classification or Supplier's identification code.

1.5 QUALITY ASSURANCE

A. Do not change material sources, or aggregate without ENGINEER's knowledge.

B. Reject backfill material that does not comply with requirements in this Section.

C. If requested, submit a quality control inspections and testing report describing source and field quality control activities performed by CONTRACTOR and Suppliers.

1.6 **STORAGE**

A. Safely stockpile backfill materials.

B. Separate differing materials, prevent mixing, and maintain optimum moisture content of backfill materials.

1.7 **SITE CONDITIONS**

A. Do not place, spread, or roll any backfill material over material that is damaged by water. Remove and replace damaged material at no additional cost to OWNER.

B. Control traffic and erosion. Keep area free of trash and debris. Repair settled, eroded, and rutted areas.

C. Reshape and compact damaged structural section to required density.

D. Restore any damaged structure to its original strength and condition.

E. Replace contaminated backfill at no additional cost to OWNER.

1.8 **SEQUENCING**

A. Coordinate backfilling operation with pipeline commissioning, Section 33 08 00.

1.9 **ACCEPTANCE**

A. General: Native material may be wasted if there is no additional cost to substitute material acceptable to ENGINEER.

B. Material: For material acceptance refer to:

1. Common fill, Section 31 05 13.
2. Aggregate base course, Section 32 11 23.
3. Cement treated fill, Section 31 05 15.

C. Lift Thickness: One test per lot.

D. Compaction: One test per lot. Verify density using nuclear tests, ASTM D 2922. Compaction standard and Lot sizes as follows:

Table 1: Compaction Standard and Lot Size

Material	Proctor	Lot Size
Subgrade	Standard	200 linear feet
Common Fill	Standard	200 linear feet per lift 25 square feet of footing area per lift
Aggregate base course	Modified	200 linear feet per lift 25 square feet of footing area per lift

NOTES
(a) Standard proctor, ASTM D 698.
(b) Modified proctor, ASTM D 1557.
(c) Lift thickness above pipe zone before compaction, 8 inches.

E. Flowable Fill Strength: Lot size is one (1) day production with sub-lots of 50 cubic yards or part thereof. Verify strength using cylinders, ASTM D 4832.

F. Grade, Cross Slope: Measured at random locations.

1.10 **WARRANTY**

A. Correct any settlement of Trench backfill or structures built over Trench backfill at no cost to OWNER.

B. Restore structures damaged by settlement at no additional cost to OWNER.

PART 2 PRODUCTS

2.1 BACKFILL MATERIALS

A. Common fill, Section 31 05 13. Granular material, CONTRACTOR's choice.

B. Aggregate base course, Section 32 11 23. Untreated base course.

C. Cement treated fill, Section 31 05 15. Use a flowable fill so vibration is not required.

D. Slag or asphalt bearing material NOT ALLOWED in trench.

2.2 WATER

A. Make arrangements for sources of water during construction and make arrangements for delivery of water to site.

B. Comply with local Laws and Regulations at no additional cost to OWNER when securing water from water utility company.

2.3 GEOTEXTILE FABRIC

A. Section 31 05 19. Use woven or non-woven stabilization-separation fabric. Select either moderate MARV or high MARV as needed.

2.4 IDENTIFICATION TAPE

A. Permanent, bright colored, continuous printed magnetic plastic tape, intended for direct burial service; not less than six (6) inches wide by four (4) mils thick. Tape shall read "**CAUTION: BURIED INSTALLATION BELOW**". Color as follows.

Red	Electric power lines, cables, conduit and lighting cables
Yellow	Gas, oil, steam, petroleum or gaseous materials
Orange	Communications, alarm, signal, cables or conduits
Blue	Potable water
Purple	Reclaimed water, irrigation and slurry lines
Green	Sewer and storm drain lines

PART 3 EXECUTION

3.1 PREPARATION

A. Implement the traffic control plan requirements, Section 01 55 26.

B. Identify required line, levels, contours, and datum.

C. Stake and flag locations of underground utilities.

D. Verify:

1. Backfill material meets gradation requirements.
2. Foundation walls are braced to support surcharge forces imposed by backfilling operations, areas to be backfilled are free of debris, snow, ice or water.
3. Trench bottom is not frozen.

E. If ground water is in the intended backfill zone, dewater.

3.2 SUBGRADE

A. Protect subgrade from desiccation, flooding, and freezing.

B. Before backfilling over Subgrade, get ENGINEER's review of Subgrade surface preparations.

C. If Subgrade is not readily compactable, get ENGINEER's permission to stabilize the subgrade:

1. Excavation for Subgrade stabilization is incidental work, Section 31 23 16.
2. Place geotextile fabric. Place acceptable fill in lifts. Compact.

3.3 PROTECTION

A. During installation or repair, plug end of pipe or fitting except when installing next section of pipe or fitting.

B. Movement of construction machinery over Work at any stage of construction is solely at CONTRACTOR's risk.

3.4 GENERAL BACKFILLING REQUIREMENTS

A. Avoid injuring and displacement of conduit, pipe and structures while compacting soil or operating equipment next to pipeline.

B. Place geotextile fabrics; Section 31 05 19.

C. Do not damage corrosion protection on pipe.

D. Repair or replace damaged pipe at no additional cost to OWNER.

E. Withdraw sheathing, shoring, piles, and similar supports as backfilling progresses. Backfill and compact all holes left by removals.

F. Provide sufficient water quality facilities to protect downstream fish and wildlife, and to meet State water quality requirements.

G. Water settling of trench backfill is not permitted. "Jetting" of trench backfill is prohibited.

3.5 PIPE ZONE

A. Maintain uniform foundation along barrel of pipe with sufficient relief for joint connections.

B. Use backfill materials meeting pipe manufacturer's recommendations.

Maximum backfill particle size is 3/4 inch for plastic pipe.

C. Do not permit free fall of backfill material that may damage pipe, pipe finish, or pipe alignment.

D. Except where piping must remain exposed for tests, fill pipe zone as soon as possible.

3.6 **TRENCH ABOVE PIPE ZONE.**

A. Maximum lift thickness before compaction is eight (8) inches.

B. Fill unauthorized excavations with material acceptable to ENGINEER at no additional cost to OWNER.

C. Do not damage adjacent structures or service lines.

D. Install continuous identification tape directly over buried lines 18 inches below finished grade.

3.7 **MODIFIED BACKFILL LAYER METHOD**

A. At discretion of CONTRACTOR, backfill may be placed in thicker layers than indicated above subject to the following provisions:

1. CONTRACTOR proves the ability of proposed method to achieve specified average compaction density.
2. ENGINEER, on the basis of test results, approves the system in writing.

B. Should CONTRACTOR find it necessary to change the method or any part of it, including the source of material, or the rate of placing the material, obtain approval of ENGINEER, who may require a further trial area.

C. If testing shows a previously approved system is no longer producing the required degree of compaction, make changes to comply.

D. Where vibration effects are creating environmental problems, make changes to eliminate problems.

3.8 **TOLERANCES**

A. Compaction: Ninety-five (95) percent or greater relative to a standard or modified proctor density, Section 31 23 26.

B. Lift Thickness (before compaction):

1. Eight (8) inches when using riding compaction equipment.
2. Six (6) inches when using hand held compaction equipment.
3. As proven in the modified backfill layer method.

C. Cement Treated Fill: Compressive strength targets are 60 psi in 28 days and 90 psi maximum in 28 days.

3.9 **FIELD QUALITY CONTROL**

A. Test trench backfilling until a compaction pattern acceptable to CONTRACTOR and ENGINEER is achieved. Continue random quality control compaction testing.

3.10 SURFACE RESTORATION

A. Provide temporary paved surfaces where trenches pass through roadways, driveway approaches or sidewalks.

B. Restore paved surfaces, Section 33 05 25.

C. Finish landscaped surfaces with grass, Section 32 92 00 or with other ground cover, Section 32 93 13.

3.11 CLEANING

A. Remove stockpiles from site when work is complete. Grade site to prevent free standing surface water.

B. Leave borrow areas clean and neat.

END OF SECTION

SECTION 33 05 23.35
TRENCHLESS UTILITY INSTALLATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Boring or jacking pipe or box culvert.

1.2 REFERENCES

A. **ASTM Standards**:

A 53 Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

1.3 SUBMITTALS

A. Details of jacking pit bracing, casing or conduit, and jacking head to be used.

B. Dimensions and support of pilot tunnel (if used).

C. Details of steel rails in pilot tunnel (if used), including true line and grade.

D. Copy of applicable permits from agency having jurisdiction.

1.4 PERFORMANCE REQUIREMENTS

A. Jack conduit to line and grade indicated. Modify jacking operation to correct any deviation. Correct misalignment in line or grade at no additional cost to OWNER.

B. Methods and equipment used in jacking casing or conduit are CONTRACTOR's choice.

C. Use workers experienced in jacking operations.

PART 2 PRODUCTS

2.1 STEEL CASING

A. ASTM A 53, Grade B steel pipe for jacking operations, minimum wall thickness of 0.375 inch, minimum yield stress of 42,000 psi. Use a casing with a diameter equal to the outside bell diameter of the pipe plus four (4) inches minimum.

B. Fillet weld joints continuous around casing and reinforce joints to withstand jacking operations.

2.2 CONCRETE PIPE

A. Section 33 05 02. When concrete pipe is to be jacked, use a pipe section designed to support the superimposed loads and the loads that may be placed upon the pipe during jacking operations. Use pipe sections that have a watertight joint.

2.3 SOIL CEMENT

A. Cement treated fill, Section 31 05 15.

B. Grout: Portland cement type, Sectio 03 61 00.

PART 3 EXECUTION

3.1 PREPARATION

A. Locate and preserve utilities, Section 31 23 16.

3.2 JACKING PROCEDURE

A. When casing is to be jacked through a plastic clay, continue uninterrupted operations until casing has been jacked between specified limits.

B. Equip leading section of casing with a jacking head securely attached to prevent any wobble or variation in alignment during jacking operation.

C. Protect driving end against spalling or other damage, and install sufficient bearing shims to intermediate joints to properly distribute jacking stresses. Remove and replace any section showing signs of failure.

D. No excavation in excess of outer dimensions of conduit being jacked will be allowed unless approved. Avoid any loss of earth outside jacking head.

E. Upon completion of jacking operations, pressure grout voids around outside face of the conduit. Grouting around jacked conduit must be started immediately after jacking operations have finished.

F. During the jacking operation, backpack with soil cement any annular space occurring outside of conduit that could affect any surface structure or facility.

3.3 PILOT TUNNEL

A. Construct tunnel where casing 60 inches or greater inside diameter is to be jacked for a distance greater than 32 feet.

B. Remove supports for tunnels as jacking progresses.

3.4 PIPE SUPPORT IN CASING TUNNEL

A. Unless indicated otherwise, use redwood skids throughout the length of the pipe tied at every pipe diameter length to brace pipe installed in casing to prevent shifting or flotation during backfilling of annular ring between the casing and carrier pipe.

B. Backfill annular ring with portland cement grout, Section 03 61 00 unless indicated otherwise.

C. Install pipe barrels to rest upon support blocks with the pipe bells clearing the casing invert by at least 1/2 inch.

D. Whenever clay pipe is installed in a casing, use mechanical compression joints.

END OF SECTION

SECTION 33 05 25
PAVEMENT RESTORATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Aggregate base restoration.

B. Concrete base restoration.

C. Pavement surface restoration.

1.2 REFERENCES

A. **APWA (Utah Chapter) Standards**:

Plan 255	Asphalt concrete T-patch.
Plan 256	Concrete pavement T-patch.
Plan 257	Concrete pavement panel replacement.

B. **ACI Standards**:

305	Hot Weather Concreting.
306	Cold Weather Concreting.

C. **ASTM Standards**:

A 615	Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
C 928	Packaged, Dry, Rapid- Hardening Cementitious Materials for Concrete Repairs.
C 1315	Liquid Membrane Forming Compounds Having Special Properties for Curing and Sealing Concrete.
D 4	Bitumen Content.
D 5	Penetration of Bituminous Materials.
D 92	Flash and Fire Points by Cleveland open Cup.
D 95	Water in Petroleum products and Bituminous Materials by Distillation.
D 113	Ductility of Bituminous Materials.
D 402	Distillation of Cut-Back Asphaltic (Bituminous) Products.
D 1664	Coating and Stripping of Bitumen-Aggregate Mixtures.
D 2041	Theoretical Maximum Specific Gravity of Bituminous Paving Mixtures.
D 2170	Standard Test Method for Kinematic Viscosity of Asphalts (Bitumens).

1.3 SUBMITTALS

A. Traffic control plan, Section 01 55 26.

B. Target sieve gradation for aggregate base.

C. Asphalt pavement mix design.

D. Portland cement concrete mix design and data sheets for joint filler board, concrete joint sealer, concrete bond breaker, concrete chemical additives, curing agent, and reinforcement.

1.4 WEATHER

A. Asphalt Pavement Restoration:

1. If air and roadbed temperatures in the shade are less than 40 deg F asphalt placement is considered a temporary patch.
2. Remove any temporary patching and provide permanent patch material when temperature exceeds 40 deg F CONTRACTOR may perform work after cold weather season if authorized in writing by ENGINEER.

B. Portland Cement Concrete Pavement Restoration:

1. Hot weather, ACI 305. Set retarding admixture may be used if allowed in mix design. Discontinue placement if ambient air temperature exceeds 100 deg F. in the shade.
2. Cold weather, ACI 306. Concrete accelerating admixtures may be used if allowed in mix design. Provide weather protection until 90 percent of design compressive strength. When removing heat, limit temperature change next to concrete surface to 20 deg F. per 12 hours until the concrete surface temperature reaches ambient:
   a. Use of admixtures or curing agent will not relax cold weather placement and cure requirements.
   b. Do not use chemical additives to prevent freezing.
   c. Prevent loss of moisture during protection.

1.5 ACCEPTANCE

A. Aggregate Base: Compaction.

B. Concrete Base: Strength.

C. Asphalt Pavement:

1. Compaction.
2. Grade and cross slope of pavement surface.
3. Surface distortion.

D. Concrete Pavement:

1. Reinforcement placement and concrete strength.
2. Grade and cross slope of pavement surface.
3. Surface distortion.

PART 2 PRODUCTS

2.1 MATERIALS

A. Aggregate Base: Untreated base course material, Section 32 11 23.

B. Flowable Fill Base: Section 31 05 15.

C. Portland Cement Concrete Base Course: Class 4000, Section 03 30 04.

D. Tack Coat: Grade SS-1, Section 32 12 13.13.

E. Permanent Marking: Tape or paint, Section 32 17 23.

2.2 ASPHALT PAVEMENT

A. Permanent Warm Weather Asphalt Concrete: AC-20-DM-1/2, Section 32 12 05 unless indicated elsewhere.

B. Temporary Cold Weather Asphalt Concrete Patching Material: Type MC-250-DM-1/2, Section 32 12 05 with hydrated lime or anti-strip agent as indicated in the mix design.

C. Pavement Sealing:

1. Slurry Seal: Type RS-1-SS-II, Section 32 01 13.61.
2. Chip Seal: Type MC-250-CS-A, Section 32 01 13.64.

2.3 CONCRETE PAVEMENT

A Chairs, Bolsters, Bar Supports, Spacers: Section 03 20 00.

B. Bond Breaker: Paraffin wax, lithium grease, or other semi-solid, inert lubricant.

C. Fillers and Sealer: Section 32 13 73:

1. Expansion joint filler, F1 sheet 1/2 inch thick.
2. Contraction joint filler (Backer Rod), closed cell: Type 1 round.
3. Contraction joint sealer, HAS1 or HAS4 hot applied.

D. Adhesive Grout: Epoxy gel type II; Section 03 61 00.

E. Reinforcement: Grade 60 ksi galvanized or epoxy coated steel, ASTM A 615:

1. Dowel Bar: Smooth with a non-metallic end cap that allows 1/4 inch longitudinal movement of bar.
2. Tie Bar: Deformed.
3. Mat: Deformed.

F. Normal Set Concrete: Class 4000, Section 03 30 04. Slump range per mix design.

G. High Early Strength Concrete:
   1. Slump range per mix design, Section 03 30 04:
   2. Concrete compressive strength of 3,000 psi minimum in four (4) hours.
   3. Cementitious Material: Rapid hardening or very rapid hardening, ASTM C 928.
   4. Cement content of mix, per cement manufacturer's recommendations or approved mix design.
   5. Non-reactive aggregates in applications subjected to wetting, extended exposure to humid atmosphere, or contact with moist ground.

H. Curing and Sealing Compound: Membrane type, ASTM C 1315:
   1. Type II Class A or B (white pigmented) for roadway pavement.
   2. Clear with red fugitive dye for concrete flat work.

PART 3 EXECUTION

3.1 CONSTRUCTION EQUIPMENT

A. Paver: Use asphalt concrete lay-down machine for final lift if surface restoration is over a trench in the direction of traffic flow or if trench is a deep (wide surface) excavation.

3.2 PREPARATION

A. Implement the traffic control plan requirements.

B. At site, post name, address and telephone number of CONTRACTOR to contact in emergencies.

C. Notify ENGINEER within 24 hours of commencing work of this Section but not less than four (4) hours.

D. Cutting Pavements: Cut full depth and straight, Section 02 41 14. Remove all bonding inhibitors.

3.3 AGGREGATE BASE

A. Match depth of existing aggregate base or at least eight (8) inches thick.

B. Place lifts not exceeding eight (8) inches before compaction. Compact each lift to 95 percent or greater relative to a modified proctor density.

3.4 CONCRETE SUBSTRATE

A. Match existing substrate thickness.

B. Apply concrete bonding compound, Section 03 30 10, to edge of existing concrete.

C. Place concrete, Section 03 30 10.

3.5 ASPHALT PAVEMENT RESTORATION

A. Follow APWA Plan 255 requirements.

B. Match existing pavement thickness plus 1 inch, but not less than four (4) inches.

C. Clean all vertical surfaces that butt against new patchwork. Provide full coverage spray tack coat. Do not spray tack coat on surfaces exposed to public view. Do not apply tack coat by brush.

D. Place asphalt concrete in lifts not exceeding three (3) inches after compaction. Compact to 94 percent of ASTM D 2041 (Rice density) plus or minus two (2) percent.

E. Match adjacent surface slopes.

F. Use lay-down machine for final lift if trench is in direction of traffic flow.

3.6 CONCRETE PAVEMENT RESTORATION

A. Full Depth Restoration:

1. Follow applicable APWA Plan 256 requirements.
2. In vertical load bearing joints, clean vertical surfaces and install tie-bars or dowels. Apply concrete bonding compound, Section 03 30 10.
3. Place concrete. Prevent segregation.
4. Match adjacent surface slopes. Match adjacent surface texture.
5. Saw cut contraction joints.

B. Partial Depth Restoration:

1. Chip, hydro-blast or saw cut concrete at least one (1) inch deep.
2. Make surfaces free of frost, ice, mud, water, grease, dirt and other materials that hamper bonding.
3. Install bonding agent per manufacturer's recommendations.
4. Place concrete. Prevent segregation.
5. Match adjacent surface slopes. Make surface texture match existing.

C. Cure:

1. Apply membrane forming compound immediately after placement to protect work from hot or cold weather. Apply total coverage in two (2) directions after texturing. Provide ASTM C 1315 and Section 03 39 00 requirements.
2. Eliminate thermal shock of concrete by keeping cure temperature even throughout extent and depth of concrete patch.

D. Traffic: Not allowed on the repaired area until concrete strength is achieved.

3.7 CONCRETE PAVERS

A. Screed bedding with a notched and cambered screed board to achieve a crown between existing pavers. Use graded aggregate, geotextile, and bedding sand, Section 32 14 13.

B. After placement, use a plate-type vibrating compactor to compact pavers. Size compactor to provide at least 5,000 lbf force. Sweep joint sand into the joints and vibrate until joints are full. Remove excess joint sand.

C. Match adjacent surface grades with no more than 1/4 inch vertical deviation in 10 feet.

3.8 TOLERANCE

A. 1/4 inch vertical deviation from design elevation in 10 feet.

B. Match adjacent surface slopes.

3.9 PAVEMENT MARKINGS

A. Unless indicated otherwise, repair all damaged Pavement markings with matching material types and installation.

3.10 REPAIR

A. Remove bumps and depressions exceeding 1/4 inch vertical deviation in 10 feet.

B. Asphalt Pavement: Repair options include mill and inlay, or grinding. Feather edges on asphalt repairs is not allowed. Apply a cationic or anionic tack emulsion to make planed surfaces water resistant.

C. Concrete Pavement: Repair options include grinding, or slab replacement. Apply a water repelling product over surfaces that are ground to make the surfaces water resistant. Repair or replace any slab that cracks, shrinks, or otherwise fails. Do not allow traffic on repaired area until concrete strength is achieved.

END OF SECTION

SECTION 33 08 00
COMMISSIONING OF WATER UTILITIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Identification of testing requirements for potable and non-potable water piping systems.

B. Warning: DO NOT use hydrostatic pressures described in this Section for air-pressure testing.

1.2 DEFINITIONS

A. **Leakage**: The quantity of water required to maintain specified hydrostatic test pressure after pipeline has been filled with water and air expelled.

B. **Non-rigid Pipe**: Any pipe that requires bedding and pipe zone backfill material for structural support.

1.3 SUBMITTALS

A. Pipeline Test Report: Submit:

1. Type of test.
2. Identification of pipe system.
3. Size, type, location and length of pipe in test section.
4. Test pressure and time.
5. Video cassette and log of visual examination.
6. Amount of leakage versus allowable.
7. Date of test approval.
8. Signature of test supervisor.
9. Signature of Resident Project Representative witnessing the test.

1.4 PROJECT CONDITIONS

A. Repair pipeline system at no additional cost to OWNER until it passes specified commissioning tests.

1.5 WARRANTY

A. At the end of the one year correction period repeat any test requested by ENGINEER to verify warranty of pipeline performance.

PART 2 PRODUCTS

2.1 TESTING MATERIALS

A. Medium: Water, air.

B. Recording Equipment (pressure systems):

1. Supply all equipment and power to perform pressure testing.
2. Secure approval of pressure gages.
3. Locate all gages and recording equipment away from affect of sunshine or unsuitable weather conditions.
4. Place, vents, pressure taps and drains for the test. Repair pipeline at completion of test at no additional cost to OWNER.

PART 3 EXECUTION

3.1 PREPARATION

A. Notify ENGINEER 48 hours in advance of test.

B. Carry out selected tests as pipeline construction progresses to ensure construction methods are producing satisfactory results.

C. Remove debris, sediment and other material from installed pipe before testing. Do not discharge or flush sand, gravel, concrete, debris or other foreign material into any existing pipeline system. Flushing with clean water only will be allowed but with minimal flows to eliminate exceeding capacities of the existing gravity systems. Flushing into existing pressurized water systems will not be allowed.

3.2 ALIGNMENT AND GRADE TEST

A. Do not allow line and grade of pipe to vary more than 1/2 inch in 10 feet and not more than 1 inch variance from true line at any location.

B. Do not allow grade of pipe to vary more than 1/4 inch in 10 feet for all design grades less than or equal to 1 percent and not more than 1/2 inch total variance from true grade at any location. Also, do not allow grade of pipe to vary more than 1/2 inch in 10 feet for all design grades greater than 1 percent and not more than 1 inch total variance from true grade at any location. Theses tolerances shall be acceptable provided that such variation does not result in a level or reverse sloping invert.

C. The variation in the invert elevation between adjoining ends of pipe due to eccentricity of joining surface and pipe interior surfaces shall not exceed 1/64 inch per inch of pipe diameter, or 1/4 inch maximum.

3.3 PRESSURE TEST

A. Air Test: Per pipe manufacturer's recommendation.

B. Hydrostatic test: Two (2) tests are required, pressure and volume.

1. Provide 225 psi test pressure for two (2) hours unless required otherwise.
2. Provide air release taps at pipeline’s highest elevations and expel all air before the test. Insert permanent plugs after test has been

completed.

3. No piping installation will be acceptable until the leakage is less than the amount allowed by industry standards for the type of pipe material being tested or if no standard prevails then the number of gallons per hour as determined by the formula:

$$Q = \frac{LD * \text{square root of } P}{133{,}200}$$

Where

Q = allowable leakage, in gallons per hour.
L = length of pipe under test in feet.
D = nominal diameter of pipe in inches.
P = average test pressure, in pounds per square inch (gage).

C. Locate and repair defective joints and retest until the leakage rate is less than allowable.

D. Repair any noticeable leakage even if total leakage is less than allowable.

3.4 OBSTRUCTION AND DEFLECTION TEST

A. Obstructions: Maximum protuberance is 1 inch.

B. Deflections:

1. Do not use mechanical pulling equipment when passing mandrels through pipe.
2. Maximum reduction of internal diameter in any plane measured full length of installation and not less than 30 days after installation as follows:
   a. Polyvinyl chloride pipe, 7.5 percent.
   b. High density polyethylene pipe, five (5) percent.
   c. Ductile iron pipe, three (3) percent.
   d. Corrugated metal pipe, 7.5 percent.
3. Recommend an alternate method of measurement if mandrel testing would cause damage to internal pipe coating.

3.5 INFILTRATION TEST

A. Maximum is 50 gallons per inch diameter per mile per 24 hours.

3.6 VIDEO TEST

A. Run water through gravity system prior to video inspection.

B. Conduct test at least 30 days after backfill and prior to installation of pavements.

C. ENGINEER to be present during video inspection.

D. Inspect measure and record host pipe conditions using digital video recording equipment in MPEG 1 format with 352x240/320x240x30 fps resolution and audio bit rate of 256 Kbps.

E. Identify the date, pipe reach, slope, upstream and downstream manhole numbers, and manhole to manhole footage.

F. Provide video inspection log as a computerized data report with a map of the system inspected with appropriate identification labels as referenced in the video.

3.7 TRACER WIRE CONTINUTIY TEST

A. Test all tracer wire sections for continuity.

3.8 PIPE TESTING SCHEDULE

A. Landscape Irrigation - Gravity System:
   1. Grade test: All laterals drain.

B. Landscape Irrigation – Pressure System:
   1. Grade test: All lateral pipe drains.
   2. Pressure test.
   3. Operational Testing:
      a. Perform operational testing after hydrostatic test is complete; backfill is in place and sprinkler heads adjusted to final coverage.
      b. Demonstrate system meets coverage requirements and automatic controls function properly.
      c. Coverage requirements are based on operation of 1 circuit at a time.

C. Sanitary Sewers:
   1. Alignment and grade test.
   2. Obstructions and deflection test.
   3. Infiltration test for gravity pipeline systems.
   4. Pressure test for pressure pipeline systems.
   5. Video inspection. For lateral replacements constructed by bursting, camera in presence of ENGINEER.
   6. Air test.

D. Subdrains:
   1. Grade test: All pipelines drain.
   2. Obstructions and deflection test.

E. Storm Drains:
   1. Alignment and grade test.
   2. Obstructions and deflection test.
   3. Infiltration test for gravity pipeline systems.
   4. Pressure test for pressure pipeline systems.
   5. Video inspection for all mains and laterals.
   6. Air test

F. Potable Water System:
   1. Obstruction and deflection test.

2. Pressure test.
3. Disinfection (Section 33 13 00).
4. Tracer wire continuity test.

G. Secondary Nonpotable Water System
1. Obstruction and deflection test.
2. Pressure test.
3. Flushing (See Section 33 13 00 disinfection not required).
4. Tracer wire continuity test.

END OF SECTION

SECTION 33 11 00
WATER DISTRIBUTION AND TRANSMISSION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Water distribution and transmission pipe systems, identification, valves, boxes, service connections and accessories.

B. This section is applicable to potable and non-potable water pressure systems.

1.2 REFERENCES

A. **American Concrete Pipe Association (ACPA) Standards**.

B. **APWA (Utah Chapter) Standards**:

Plan 255	Asphalt Concrete "T" Patch.
Plan 256	Concrete Pavement Patch.
Plan 381	Trench Backfill.
Plan 382	Pipe Zone Backfill.
Plan 521	3/4" and 1" Meter.
Plan 522	1-1/2" and 2" Meter.
Plan 541	Water Service Line.
Plan 542	Water Service Line Loop.
Plan 543	Watermain Loop.
Plan 551	3/4" and 1" Service Taps.
Plan 552	1-1/2" and 2" Service Taps.
Plan 561	Direct Bearring thrust Block.
Plan 562	Tie-Down Trust Restraints.
Plan 574	Cover Collar for Water Valve Boxes.

C. **AWWA Standards**:

C600	Installation of Ductile-Iron Water Mains and Their Appurtenances.
C605	Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water.
C800	Underground Service Line Valves and Fittings.
C901	Polyethylene (PE) Pressure Pipe and Tubing, 1/2 in. Through 3 in., for Water Service.
M11	Manual for Steel Pipe - Design and Installation.

D. **Copper Development Association (CDA) Standards**.

E. Applicable water company requirements standards.

1.3 PERFORMANCE REQUIREMENTS

A. Depth of Cover:

1. Minimum as indicated in local building code from top of pipe to ground surface. 72 inches maximum unless ENGINEER authorizes otherwise.
2. If less cover, provide additional protection to withstand frost and external loads.

B. Remove any section of pipe already placed that is found to be defective or damaged. Relay or replace without additional cost to OWNER.

1.4 SUBMITTALS

A. Product data: Submit manufacturer's technical product data and installation instructions.

B. Commissioning: Submit testing data indicated in Section 33 08 00.

C. Record Documents, Section 01 78 39: Include details of underground structures, connections, thrust blocks and anchors. Show interface and spatial relationship between piping and adjacent structures.

D. Operating and Maintenance: Submit data, Section 01 78 23. Include maintenance data, parts list, product data and Shop Drawings.

1.5 SITE CONDITIONS

A. Minimize neighborhood traffic interruptions. Barricade stockpiles.

B. Secure acceptance of pipeline lateral tie-in work.

C. Repair public and private facilities damaged by CONTRACTOR.

D. Do not operate any currently active water valve until its owner and water company's permission is secured.

PART 2 PRODUCTS

2.1 PIPES AND FITTINGS

A. Provide piping materials and factory fabricated piping products of sizes, types, pressure ratings, and capacities indicated. Use only NSF approved products in drinking water systems. All such products shall be appropriately stamped with the NSF logo.

B. Where not indicated, provide proper selection as determined by installer and acceptable to ENGINEER to comply with installation requirements.

C. Provide sizes and types of equipment connections for fittings of material that matches pipe material used in the piping system. Where more than one type of material or product option is indicated, selection is installer's choice.

D. Provide pipe fittings and accessories of same material and weight or class as pipe, with joining method indicated or recommended by manufacturer.

2.2 VALVES

A. Section 33 12 16.

2.3 **VALVE BOX**

A. Buried Valves in Traffic Areas: Cast iron two (2) piece slip sleeve type, 5-1/4 inch shaft, with a drop lid.

B. Buried Valves in Non-Traffic Areas: Cast iron two (2) piece screw adjustable sleeve of height required for installation.

C. Markings: Cast appropriate utility lettering on cover.

2.4 **VALVE CHAMBER**

A. Basin: Class 4000 concrete floor and walls.

B. Steps: Plastic, cast into sidewalls greater than four (4) feet deep.

C. Top: Flat slab class 4000 concrete.

D. Frame and Cover: Scoriated asphalt coated, heavy duty ductile iron conforming to Section 05 56 00 with flat top design and appropriate utility lettering. Shape and size required.

2.5 **MORTAR, GROUT, AND CONCRETE**

A. Mortar: Portland cement, Section 04 05 16.

B. Grout: Portland cement, Section 03 61 00.

C. Concrete:

1. Cast-in-place: Class 4000, Section 03 30 04.
2. Precast: Class 5000, Section 03 40 00.

2.6 **TAPPING SADDLES**

A. Bronze alloy or stainless steel saddles with stainless steel straps (double straps on pipes over 12 inches diameter).

B. Straight threads. Tappered threads not allowed.

C. Rated working pressure, 300 psi minimum.

D. Neoprene Buna N gaskets.

2.7 **SERVICE CONNECTION**

A. Taps: Saddle clamp or direct type. Provide plastic spacers or nipples to separate non-similar metals.

B. Service Line:

1. Copper Pipe: Type K, Section 33 05 03 with 200 psi compression fittings according to AWWA C800.
2. Polyethylene Pipe: AWWA C901 with 200 psi compression fittings, and ratings according to AWWA C800.

2.8 ACCESSORIES

A. Bolts, Nuts, Washers: Steel, Section 05 05 23.

B. Anchorages: Provide anchorages for tees, wyes, crosses, plugs, caps, bends, valves, and hydrants. After installation, apply full coat of asphalt or other acceptable corrosion-retarding material to surfaces of ferrous anchorages.

C. Corporation Stops: All bronze, straight threads, full port, ball valve.

D. Hydrant and Valve: Dry barrel, Section 33 12 19.

E. Water Meter and Valve: Section 33 12 19.

F. Grease: Non-oxide food grade required where in contact with potable water. Non-oxide poly-fm for all exposed buried metal surfaces for bolts, nuts, washers, restraints, etc.

G. Polyethylene Sheet: Six (6) mil thick minimum.

H. Joint Restraints: Acceptable to ENGINEER prior to installation.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify trench excavation is ready to receive work, and dimensions, and elevations are as required.

B. Commencing installation means acceptance of existing conditions.

3.2 PREPARATION

A. Excavation, Section 31 23 16. Hand trim to required elevations. Correct over excavations.

B. Remove stones or other hard matter that manufacturer stipulates may damage pipe during embedment or impede backfilling or compaction.

C. Examine areas and conditions under which materials and products are to be installed. Do not proceed with system installation until unsatisfactory conditions have been corrected in manner acceptable to system installer.

D. Clearly identify and promptly set aside defective or damaged pipe.

E. Use pipe cutting tool acceptable to pipe manufacturer.

3.3 LAYOUT

A. Comply with Utah administrative rules R309-550. As a minimum locate potable water pipe at least 18 inches vertical and 10 feet horizontal edge to edge between water and sewer lines. Place water lines above sewer line.

B. Where potable water pipe crosses under gravity-flow sewer lines, fully encase sewer pipe in concrete for a distance at least 10 feet each side of the crossing:

1. Do not locate any joint in the water line within 36 inches of the crossing.

2. Encase water line if it is within 24 inches of a sewer force main or a sewer inverted syphon.
3. Encase sewer main joints in concrete if joints are horizontally closer than 36 inches to the water line.

C. Do not put potable water lines in the same trench with sewer lines, storm drains or electric wires.

3.4 **INSTALLATION - PIPE AND FITTING**

A. General:
1. Seal each open end of pipeline at end of day's work.
2. Grease all bolts and nuts then apply polyethylene sheet and tape wrap.

B. Steel Pipe: AWWA M11.

C. Ductile Iron Pipe: AWWA C600.

D. Copper Tube: CDA "Copper Tube Handbook".

E. Polyethylene Pipe: For three (3) inches and smaller pipe follow AWWA C901. Install all other sizes per manufacturer's installation instructions.

F. Polyvinyl Chloride Pipe: AWWA C605.

G. Concrete Pipe: ACPA "Concrete Pipe Handbook".

H. Wedges: Install metal wedges on metal pipe systems. Grease and plastic wrap exposed metal wedges.

3.5 **INSTALLATION – CONCRETE THRUST BLOCK**

A. APWA Plan 561 or 562.

B. Do not make hydrostatic tests of Section 33 08 00 until thrust block concrete has cured for at least five (5) days.

C. Provide thrust blocks on all plugs, caps, tees, hydrants and vertical or horizontal elbows.

D. Provide stainless steel or epoxy coated steel tie rods and clamps or shackles to restrain thrust.

E. Unless indicated otherwise or directed by ENGINEER, place base and bearing sides of thrust blocking directly against undisturbed earth.

F. Sides of thrust blocking not subject to thrust may be placed against forms. Place thrust blocking so joint fittings will be accessible for repair.

3.6 **INSTALLATION - VALVE AND VALVE BOX**

A. Valves:
1. Ensure all parts are in working order.
2. Set location of valves outside of sidewalk limits, driveway approach and other pedestrian or vehicular interference.
3. Install plumb with stem pointing up.
4. Grease all exposed bolts and nuts then apply polyethylene sheet and tape wrap.

B. Air Relief Valves:

1. At high points in water mains where air can accumulate, air may be removed by means of hydrants or air relief valves.
2. DO NOT use automatic air relief valves where flooding may occur.

C. Valve Box:

1. Set over valve nut so operator's key is plumb with clearance in valve box when opening and closing the valve. Riser must NOT rest on valve or pipe system.
2. Adjust riser to finish grade and clean all dirt or foreign material out of riser.
3. Install concrete cover collar in paved surface, APWA Plan 574.

3.7 INSTALLATION – JOINT RESTRAINTS

A. Without Thrust Blocks: Install joint restraints with all valves for the distance acceptable to the ENGINEER.

B. With Thrust Blocks: Install joint restraints for the distance approved by the ENGINEER where concrete block design exceeds three (3) cubic yards, for vertical bends, where soil is disturbed, or where undisturbed soil bearing capacity is less than 1000 pounds per square foot.

3.8 INSTALLATION – TAPS

A. APWA Plan 551 or 552.

B. Apply for and pay for applicable permits from water company for size and location of tap to water main. Comply with all connection requirements of water company.

C. Make service taps with a tapping machine acceptable to water company. Use teflon tape on all taps unless indicated otherwise.

D. Minimum distance between taps is 24 inches, with a five (5) degree stagger. Do not make service taps within 24 inches of the end of pipe. Install taps at 60 degrees from vertical, or authorized by ENGINEER.

E. Service saddles are required on all taps except, 3/4 inch or 1 inch taps to new ductile iron pipe

F. Grease all exposed bolts and nuts then apply six (6) mil thick polyethylene sheet and tape wrap.

3.9 INSTALLATION – SERVICE LINE

A. Replacing Existing Water Service Line: APWA Plan 541.

1. Follow AWWA C800, Utah drinking water Rules and Regulations and International Building Code requirements.
2. When replacing water service lines, replace non-copper pipe with:
   a. Type K copper pipe, Section 33 05 03, or
   b. Polyethylene pipe, AWWA C901
3. Minimum pipe diameter 3/4 inch, maximum 3 inches.
4. Distance from nearest joint or existing tap is 24 inches minimum unless a greater distance is required by pipe manufacturer.

B. Looping Existing Water Service: APWA Plan 542.
   1. Minimum pipe diameter is one (1) inch.
   2. Use liquid nitrogen to spot freeze active service lines. Pinching tools used to close active service lines may be used only if allowed in writing by ENGINEER.
   3. Soldered joints or connections not allowed.
   4. For copper to iron connections use a brass pack joint compression coupling with joint locking device.
   5. For copper-to-copper connections use a brass compression fittings. Flared end fittings are not allowed.

C. Meter box: APWA Plan 521 or 522. Install meter box back of curb, outside of sidewalk, outside of driveway approaches, or other vehicular or pedestrian interference.

3.10 **INSTALLATION – WATERMAIN LOOP (SYPHON)**

A. APWA Plan 543.

B. Existing water mains may not match standard size. Excavate to obtain actual pipe diameter and match size.

C. Do not shutdown pipeline until couplings and fittings are on site. Coordinate shutdown with water company.

D. Connections to steel or transite pipe require transition couplings or sleeves with transition gaskets.

E. Grease all exposed bolts and nuts then apply six (6) mil thick polyethylene sheet and tape wrap.

F. Provide thrust blocks except where joints are welded. Follow details shown on drawings.

3.11 **DISINFECTION**

A. Secion 33 13 00.

B. After disinfection, legally dispose of disinfection water.

3.12 **BACKFILLING**

A. Before Backfilling:
   1. Secure ENGINEER's acceptance of brass wedge installation and concrete thrust block installation.
   2. For pressure pipe testing follow Section 33 08 00 requirements and for disinfection follow Section 33 13 00 requirements.

B. Trenches: Section 33 05 20:
   1. Pipe zone backfill, APWA Plan 382.
   2. Trench backfill, APWA Plan 381.

C. Landscapes: Section 31 23 23.

3.13 SURFACING RESTORATION

A. Roadway Trenches and Patches: Section 33 05 25:

1. Asphalt concrete "T" patch, APWA Plan 255.
2. Concrete pavement patch, APWA Plan 256.

B. Landscapes: Turfs and grass, Section 32 92 00 or Ground Cover, Section 32 93 13 as applicable.

END OF SECTION

SECTION 33 11 11
RELOCATE WATER METERS AND FIRE HYDRANTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Relocate existing water meters or fire hydrants because of changes in grade or installation of new improvements that conflict with existing meter and hydrant locations.

1.2 REFERENCES

A. **APWA (Utah Chapter) Standards**:

Plan 543 Fire hydrant replacement or relocation.

B. **AWWA Standards**:

C203 Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape – Hot-Applied.

C502 Dry-Barrel Fire Hydrants.

1.3 JOB CONDITIONS

A. Secure utility company permit to do relocation work and pay applicable fees.

B. Secure utility company approval of joints, connections, and pipe installations before commencing backfill operations.

PART 2 PRODUCTS

2.1 HYDRANTS

A. Use existing hydrant unless contracted to provide a new unit.

2.2 WATER SERVICE METERS

A. Use existing water meter and yoke unless contracted to provide a new unit.

2.3 CONCRETE

A. Class 3000 or 4000 cast-in-place, Section 03 30 04.

PART 3 EXECUTION

3.1 PREPARATION

A. Before commencing work, coordinate location and shutdown of utility lines with utility company and residents, Section 01 31 13.

B. Protect existing hydrants and meters from damage.

C. Control ground water, surface water, storm water.

D. Control pedesrian and vehicular traffic, Section 01 55 26.

E. Provide all excavation backfill, compaction, connections, testing, and surface restorations to made the installation complete.

3.2 **MOVE EXISTING HYDRANT**

A. APWA Plan 546. Relocate to location indicated.

B. Do not disturb location of hydrant lateral tee at water main.

C. The method of harnessing the hydrant (reshackling or reblocking) shall match existing conditions or approval of ENGINEER.

D. Install hydrant so base flange is even with or less than four (4) inches above grade of surrounding surface.

E. Use same type of pipe material as used for existing hydrant piping unless indicated otherwise.

F. Use mechanical and flange joint fittings unless required otherwise. Use only new tees, fittings, and bends.

G. Coat all weld connections and damaged areas of metal piping with coal tar enamel. Follow AWWA C203 requirements. Tape wrap coatings.

3.3 **RECONNECT EXISTING HYDRANT**

A. Hydrant reconnection shall meet new work requirements indicated in Section 33 12 19.

B. When existing tee on water main is to be moved to new location, seal and shackle old tee.

3.4 **HYDRANT BARREL EXTENSION**

A. Follow AWWA C502 to extend barrel, operating stem and flanged adapters in design material and workmanship so hydrant base flange is even with or less than four (4) inches above grade of surrounding surface.

3.5 **MOVE WATER METER AND BOX**

A. Verify with water company for use of Type K copper pipe (Section 33 05 03) or polyethylene pipe (Section 33 05 06) from main to meter yoke.

B. Follow installation procedure in Section 33 12 33. In paved surfaces, follow procedure in Section 33 05 14 when adjusting structures to grade.

3.6 **FIELD QUALITY CONTROL**

A. Hydrostatic tests, Section 33 08 00.

B. Disinfection, Section 33 13 00.

END OF SECTION

SECTION 33 12 16
WATER VALVES

PART 1 GENERAL

1.1. SECTION INCLUDES

A. Gate, butterfly, plug, check, pressure reducing, pressure relief, control valves and their installation.

1.2 REFERENCES

A. **AWWA Standards**:

C111 Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings.

C504 Rubber-Seated Butterfly Valves.

C508 Swing-Check Valves for Waterworks Service, 2 In. Through 24 In. NPS.

C509 Resilient-Seated Gate Valves for Water and Sewerage Systems.

C550 Protective Interior Coatings for Valves and Hydrants.

C600 Installation of Ductile-Iron Water Mains and Their Appurtenances.

1.3 SUBMITTALS

A. Provide technical information for evaluating quality of valve. As a minimum include dimensions, weights, materials lists and operation charts.

PART 2 PRODUCTS

2.1 VALVES - GENERAL

A. Underground:

1. Less than three (3) inches: Screwed ends.
2. 3 inches and larger: Flanged or mechanical joint ends. Non-rising stem. Two inches square operating nut. Low alloy steel bolts, AWWA C111.

B. Submerged or Above Sewage or Water:

1. Valve body bolts per manufacturer's recommendations.
2. For joining valve to piping system use stainless steel nuts and bolts, Section 05 05 23.

C. Below an Operating Deck: Provide shaft extension from the valve to deck level.

D. Above Ground: Non-rising stems equipped with a hand wheel.

E. Manually Operated Valves Over six (6) feet Above Operating Level: Provide chain operated handles.

F. Clearance: Install so handles clear all obstruction when moved from open to closed.

G. Rated Working Pressure: 150 psi if not indicated.

H. Coating: Interior, AWWA C550. Exterior per manufacturer's recommendation.

2.2 **GATE VALVES**

A. AWWA C509.

B. 3 inches through 48 inches, cast iron body, bronze mounted, non-rising stem with "O" ring seals.

C. Open counterclockwise.

2.3 **BUTTERFLY VALVES**

A. AWWA C504.

B. 3 inches through 48 inches, cast iron body, bronze mounted.

C. Short body if disc will not interfere with adjacent fittings or long body at CONTRACTOR's option.

D. Wafer Valves: Subject to ENGINEER's approval.

2.4 **ECCENTRIC PLUG VALVES**

A. Material: Cast iron body, bronze mounted, non-lubricated, eccentric, quarter-turn type with resilient face plugs, ductile iron discs with upper and lower shafts integral.

B. Markings: Indicate open and close position.

C. Port Areas: At least 82 percent of full pipe area.

D. Resilient Seat Seals: Buna N, field replaceable.

2.5 **CHECK VALVES**

A. AWWA C508.

B. Less than three (3) inches: Y-pattern, bronze, regrinding, swing check valve, 200 psi working pressure.

C. 3 inches and larger: Iron body, bronze mounted, swing valves with stainless steel hinge pins and outside weight and lever if not indicated otherwise.

2.6 PRESSURE REDUCING VALVES - SERVICE LINE

A. Operation: Capable of reducing a varying higher upstream pressure to an adjustable constant lower downstream pressure.

B. Spring and nylon reinforced diaphragm type construction.

C. Equip with Y-strainer upstream of valve.

2.7 PRESSURE REDUCING VALVES - MAIN LINE

A. Operation: Capable of maintaining an adjustable constant downstream pressure regardless of upstream pressure.

B. Type: Hydraulically operated using a direct-acting, spring-loaded, normally open, pilot valve controlled diaphragm:

1. Single removable seat and a resilient disc. No "O" ring type discs permitted. No external packing glands permitted. No pistons operating main valve or pilot controls permitted.

2. Y-strainers on pilot controls, variable closing and opening speed controls and a valve position indicator.

C. Rating: 250 psi working pressure.

D. Connection: Flanged.

E. Pressure Gage: Upstream and downstream of valve capable of accurately measuring system pressures.

2.8 PRESSURE RELIEF VALVES

A. Operation: Maintain a constant upstream pressure by passing or relieving excess pressure.

B. Closed Valves: Drip-tight.

C. Type: Hydraulically operated, pilot control using a diaphragm with a single removable seat and resilient disc.

D. Pilot Controls: Direct acting, adjustable between 20 and 200 psi, spring-loaded diaphragm valve.

E. Rating: 250 psi working pressure.

F. Connection: Flanged.

2.9 CONTROL VALVE

A. Globe: Diaphragm actuated, single seated, composition disc, hydraulically operated.

B. Pilot Controls: Externally mounted, four-way, solenoid pilot valve with self cleaning strainers and diaphragm type check valves:

1. Equipped with a limit switch for pump control.

2. Equipped with a built-in lift check valve to prevent flow reversal.

E. Rating: 250 psi working pressure.

F. Connection: Flanged.

G. Solenoids and Limit Switch: Supplied with operating voltage indicated.

PART 3 EXECUTION

3.1 INSTALLATION

A. Flush all lines before valve installation.

B. In ductile iron water mains, AWWA C600.

C. Install butterfly valve shafts vertical in vault boxes and horizontal otherwise.

END OF SECTION

SECTION 33 13 00
DISINFECTION

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Disinfection of potable water system.

B. Test and report results.

1.2 **REFERENCES**

A. **AWWA Standards**:

A100 Water Wells.

B300 Hypochlorites.

B301 Liquid Chlorine.

C651 Disinfecting Water Mains.

C652 Disinfection of Water-Storage Facilities.

B. **State of Utah Standards**:

Public Drinking Water Regulations, Part 2, Section 12.

1.3 **DEFINITIONS**

A. **Disinfectant Residual**: The quantity of disinfectant in treated water.

B. **ppm**: Parts per million.

1.4 **SUBMITTALS**

A. CONTRACTOR's evidence of experience in disinfection.

B. Bacteriological laboratory's certification.

C. Disinfection Report: Three (3) copies containing:

1. Date issued.
2. Project name and location.
3. Treatment contractor's name, address and phone number.
4. Type and form of disinfectant used.
5. Time and date of disinfectant injection started.
6. Time and date of disinfectant injection completed.
7. Test locations.
8. Initial and follow-up disinfectant residuals in ppm for each outlet tested.
9. Time and date of flushing start.
10. Time and date of flushing completion.
11. Disinfectant residual after flushing in ppm for each outlet tested.
12. Flush water disposal location and acceptance by local agency.

D. Bacteriological Report: Three (3) copies including:
   1. Date issued.
   2. Project name and location.
   3. Laboratory's name, certification number, address, and phone number.
   4. Time and date of water sample collection.
   5. Name of person collecting samples.
   6. Test locations.
   7. Time and date of laboratory test start.
   8. Coliform bacteria test results for each outlet tested.
   9. Certification that water conforms or fails to conform to bacterial standards of State of Utah public drinking water regulations.
   10. Bacteriologist's signature.

1.5 **QUALITY ASSURANCE**

A. Bacteriological Laboratory: Certified by State of Utah if laboratory is other than OWNER's laboratory.

1.6 **PRODUCT HANDLING**

A. Store and protect disinfectant in accordance with manufacturer's recommendations to protect against damage or contamination. Do not use unsuitable disinfectant.

B. Follow all instruction labeling for safe handling and storage of disinfectant materials.

1.7 **REGULATORY REQUIREMENTS**

A. Conform to State of Utah public drinking water regulations.

PART 2 PRODUCTS

2.1 **DISINFECTANT**

A. AWWA B301. Liquid chlorine 99.5 percent pure by volume.

B. AWWA B300. Sodium hypochlorite not less than 100 grams per liter available chlorine.

C. AWWA B300. Calcium hypochlorite 65 to 70 percent available chlorine by weight in granular form.

D. Powder, tablet, or gas according to manufacturer's specification.

2.2 **ALKALI**

A. Caustic soda or soda ash.

2.3 **ACID**

A. Hydrochloric (muriatic).

PART 3 EXECUTION

3.1 PREPARATION

A. Provide necessary signs, barricades, and notices to prevent accidental exposure to disinfecting materials, consuming disinfecting water, or disturbing system being disinfected.

B. Make sure potable water system is complete, clean, and that the system to be disinfected is not connected to an existing system.

3.2 DISINFECTION OF WATER LINES

A. Use one method defined under AWWA C651 that is acceptable to ENGINEER.

B. After pressure testing per Section 33 08 00, flush system through hydrants or if a hydrant does not exist, install a tap of sufficient size to provide 2.5 feet per second flushing velocity in the line.

C. Starting at outlet closest to water source, bleed water from each outlet until chlorine residual reaches outlet. Repeat process at each outlet throughout system.

D. Collect a bacteriological water sample at end of line to be tested. If sample fails bacteriological test, flush system and retest. Continue flushing and retesting until a good sample is obtained.

E. If flushing does not produce a passing bacteriological test disperse disinfectant throughout system to obtain 10 to 25 ppm of free chlorine residual.

F. Flush the chlorinated water from the main until chlorine measurements show concentration in the water leaving the main is no higher than that generally prevailing in the system or is acceptable for domestic use.

G. After a passing bacteriological test sample is obtained, let the system relax for 24 hours. Flush and collect a subsequent bacteriological sample for testing. If the subsequent test passes then water line is acceptable.

3.3 DISINFECTION OF CULINARY WELLS

A. Use one method defined under AWWA A100 that is acceptable to ENGINEER.

B. Do not start disinfection until well is thoroughly cleaned.

C. Use a disinfecting solution containing a minimum of 50 ppm residual chlorine.

D. Flush system after disinfection.

3.4 DISINFECTION OF WATER STORAGE RESERVOIRS

A. Use one method defined under AWWA C652 that is acceptable to ENGINEER.

B. Do not start disinfection until water storage tank is thoroughly cleaned.

C. Provide and use necessary safety equipment for workers in contact with disinfectant or gasses.

D. Flush system after disinfection.

3.5 FIELD QUALITY CONTROL

A. Bacteriological Test:

1. Collect samples for testing no sooner than 16 hours after system flushing.
2. Analyze water samples per State of Utah requirements.
3. If bacteriological test proves water quality to be unacceptable, repeat system treatment.
4. Do not place water systems into service until a passing bacteriological test is made. Provide a copy of the passing test to ENGINEER.

B. Disposal of Disinfectant:

1. Legally dispose of disinfecting water and ensure no chlorine buildup or damage to the environment.

END OF SECTION

SECTION 33 31 00
SANITARY SEWERAGE SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Gravity sanitary sewerage systems.

B. Pressure sanitary sewerage systems are indicated in Section 33 11 00.

1.2 REFERENCES

A. **ASTM Standards**:

C 478 Precast Reinforced Concrete Manhole Section.

C 891 Installation of Underground Precast Concrete Utility Structures.

C 923 Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals.

1.3 PERFORMANCE REQUIREMENTS

A. Vertical Cover: Unless indicated otherwise, two (2) feet minimum for laterals and four (4) feet when subjected to light construction equipment loads.

B. Remove any section of pipe already placed that is found to be out of alignment tolerance, defective, or damaged. Relay or replace at no additional cost to OWNER.

1.4 PROJECT CONDITIONS

A. Minimize neighborhood traffic interruptions. Barricade stockpiles.

B. Provide access to adjacent properties for local traffic and pedestrians, Section 01 31 13.

C. Repair public and private facilities damaged by CONTRACTOR.

D. Before Backfilling: Commission pipeline per Section 33 08 00. Provide sizes and types of equipment connections and fittings that match pipe materials when pressure testing system.

1.5 ACCEPTANCE

A. Each sanitary sewer system component must pass applicable requirements in Section 33 08 00.

PART 2 PRODUCTS

2.1 PIPING AND FITTINGS

A. Provide piping materials and factory fabricated piping products of sizes, types, and classes required.

B. Where not indicated, select product acceptable to ENGINEER and comply with installation requirements.

C. Provide pipe fittings and accessories of same material and weight or class as pipe, with joining method indicated or recommended by manufacturer.

2.2 MORTAR, GROUT AND CONCRETE

A. Portland cement mortar, Section 04 05 16.

B. Non-shrink grout, Section 03 61 00.

C. Concrete:

1. Cast-in-place: Class 4000, Section 03 30 04.
2. Precast Concrete: Class 5000 minimum, Section 03 40 00.

2.3 MANHOLES

A. Basin: Concrete floor and walls, or ASTM C 478 precast concrete.

B. Steps: None.

C. Top: Concentric cone. Concentric flat slab concrete deck allowed only with ENGINEER's permission.

D. Frame and Cover: Scoriated, asphalt coated, heavy duty, ductile iron Section 05 56 00, with flat top design meeting load rating H-20 and appropriate utility lettering. Shape, size and lifting device as necessary.

E. Pipe Connectors:

1. Precast Bases: Resilient, ASTM C 923. Sand mortar grout pipe connections.
2. Cast in Place or Connections to Existing Fixture with Plastic Pipe: Use rubber adapter gasket for precast sections. Grout, Section 03 61 00 for cast in place sections.

F. Joints in Sections: Bituminous mastic gasket-type sealant or otherwise acceptable to ENGINEER.

PART 3 EXECUTION

3.1 PREPARATION

A. Verify trench excavation is ready to receive work, and dimensions, and elevations are correct.

B. Hand trim excavations to required elevations. Backfill over excavations and compact, Section 31 23 26.

C. Examine areas and conditions under which materials and products are to be installed. Do not proceed with system installation until unsatisfactory conditions have been corrected in manner acceptable to system installer.

D. Clearly identify and promptly set aside defective or damaged pipe.

E. Use pipe cutting tool acceptable to pipe manufacturer.

3.2 **PIPE AND FITTINGS**

A. Place bell or groove end facing upstream.

B. Install gaskets per manufacturer's recommendations.

C. Plug pipeline branches, stubs or other open ends that are not to be immediately connected.

D. Clean interior of pipe of dirt and debris as work progresses.

E. Meet line and grade tolerance in Section 33 08 00. Use a laser device or demonstrate an equivalent method of establishing line and grade.

3.3 **MANHOLES**

A. Form bottom of excavation clean and smooth to correct elevation.

B. Place structures in location indicated.

C. Install precast units, ASTM C 891.

D. Provide elevations and pipe inverts for inlets and outlets indicated.

E. When structures occur in pavements, mount frame and cover 1/2 inch below finished surface. Provide a concrete cover collar between the frame and asphalt pavement. Elsewhere set frame and cover three (3) inches above finished grade.

3.4 **ABANDONED UTILITIES**

A. Use concrete to plug and cap all open ends of abandoned underground utilities which are to remain in place.

B. Provide closure to withstand hydrostatic or earth pressure that may result after ends of abandoned utilities have been closed.

3.5 **TAP CONNECTIONS - 6 INCHES AND SMALLER**

A. Field cutting into new or existing piping will not be permitted unless written permission is obtained from ENGINEER.

B. Make connections to existing pipe and underground structures, so connections will conform as nearly as practicable to requirements specified for new work.

C. Use commercially manufactured wyes for branch connections. Spring wyes into existing line and encase entire wye, plus six (6) inches overlap, with not less than six (6) inches of concrete.

D. For taps into existing 24 inches or larger piping, or to underground structures, cut opening into unit sufficiently large to allow three (3) inches of concrete to be packed around entering connection. Cut ends of connection passing through pipe or structure wall to conform to shape of and parallel with inside wall, unless otherwise indicated. Grout connection to provide smooth transition inlet into pipe.

3.6 TAP CONNECTIONS - LARGER THAN 6 INCHES

A. Not allowed. Provide a manhole structure.

3.7 JOINTS

A. Join pipe per manufacturer's recommendation or allowed.

B. Join Pipe of Different Sizes: At manholes only.

C. Use neoprene couplings with stainless steel bands to make connections between dissimilar pipe, or where standard pipeline joints are impractical.

3.8 COMMISSIONING

A. Before backfilling, commission pipeline, Section 33 08 00. Provide sizes and types of equipment connections and fittings that match pipe materials when pressure testing system.

B. Provide temporary paved surfaces where trenches pass through roadways, driveways, or sidewalks.

3.9 CLEANING

A. Remove debris, concrete, or other extraneous material that accumulates in existing pipes or structures.

B. Clean all pipelines after testing. Do not flush sand, gravel, concrete, debris or other materials into existing piping systems.

END OF SECTION

SECTION 33 41 00
STORM DRAINAGE SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Gravity systems such as irrigation, sub-drains, and storm drains.

B. Pressure storm drain systems are indicated in Section 33 11 00

1.2 REFERENCES

A. **ASTM Standards**:

C 478 Precast Reinforced Concrete Manhole Section.

C 891 Installation of Underground Precast Concrete Utility Structures.

C 923 Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals.

1.3 PERFORMANCE REQUIREMENTS

A. Vertical Cover: Two (2) feet minimum or as indicated.

B. Remove any section of pipe already placed that is found to be out of alignment tolerance defective, or damaged. Relay or replace without additional cost to OWNER.

1.4 PROJECT CONDITIONS

A. Minimize neighborhood traffic interruptions. Barricade stockpiles.

B. Provide access to adjacent properties for local traffic and pedestrians, Section 01 31 13.

C. Repair public and private facilities damaged by CONTRACTOR.

D. Before Backfilling: Commission pipeline per Section 33 08 00. Provide sizes and types of equipment connections and fittings that match pipe materials when pressure testing system.

1.5 ACCEPTANCE

A. Each storm drain system component must pass applicable requirements in Section 33 08 00.

PART 2 PRODUCTS

2.1 PIPING AND FITTINGS

A. Provide piping materials and factory fabricated piping products of sizes, types, and classes required.

B. Where not indicated, select product acceptable to ENGINEER and comply with installation requirements.

C. Provide pipe fittings and accessories of same material and weight or class as pipe, with joining method indicated or recommended by manufacturer.

2.2 IN-PLANE WALL DRAINAGE

A. Drainage Core: Manufacturer's standard three-dimensional non-bio-degradable, plastic designed to effectively conduct water to foundation drainage system.

B. Filter Fabric: Manufacturer's standard non-woven geotextile fabric of polypropylene or polyester fibers, or combination.

2.3 SUB DRAIN FILL MATERIALS

A. Sewer rock, Section 32 11 23 and geotextile, Section 31 05 19.

2.4 MORTAR, GROUT AND CONCRETE

A. Portland cement mortar, Section 04 05 16.

B. Non-shrink grout, Section 03 61 00.

C Concrete:

1. Cast-in-place: Class 4000, Section 03 30 04.
2. Precast Concrete: Class 5000 minimum, Section 03 40 00.

2.5 CLEANOUTS AND MANHOLES

A. Basin: Concrete floor with cast in place concrete walls or ASTM C 478 precast concrete.

B. Steps: None.

C. Top: Concentric cone. Concentric flat slab concrete deck allowed only with ENGINEER's permission.

D. Frame and Cover: Scoriated, asphalt coated, heavy duty, ductile iron Section 05 56 00, with flat top design meeting load rating H-20 and appropriate utility lettering. Shape, size and lifting device as necessary.

E. Pipe Connectors:

1. Precast Bases: Resilient, ASTM C 923. Sand mortar grout pipe connections.
2. Cast in Place or Connections to Existing Manhole with Plastic Pipe: Use rubber adapter gasket for precast sections. Grout, Section 03 61 00 for cast in place sections.

F. Joints in Sections: Bituminous mastic gasket-type sealant or otherwise acceptable to ENGINEER.

2.6 INLETS AND CATCH BASINS

A. Basin: Concrete floor and walls.

B. Pipe Connectors: Resilient, ASTM C 923. Sand mortar grout.

C. Frame and Grate:

1. Asphalt coated, heavy duty, cast iron, Section 05 56 00. Shape and size indicated.
2. Galvanized, heavy duty, steel: Sections 05 12 00 and 05 05 10.

Shape and size as indicated.

2.7 **OUTFALLS**

A. Cast-in-place or precast concrete with reinforced headwall, apron, and tapered sides. Provide riprap, Section 31 37 00, if indicated.

2.8 **DRAIN PIPE JOINT SCREENS**

A. Heavy mesh burlap, coal-tar saturated felt, 18 to 14 mesh copper screening or synthetic drainage fabric.

B. Plastic or corrosion resistant metal bands.

PART 3 EXECUTION

3.1 **PREPARATION**

A. Verify trench excavation is ready to receive work, and dimensions, and elevations are corrected.

B. Hand-trim excavations to required elevations. Backfill over excavations and compact, Section 31 23 26.

C. Remove stones larger than two (2) inches or other hard matter that could damage pipe or impede backfilling or compaction.

D. Examine areas and conditions under which materials and products are to be installed. Do not proceed with system installation until unsatisfactory conditions have been corrected in manner acceptable to system installer.

E. Clearly identify and promptly set aside defective or damaged pipe.

F. Use pipe cutting tool acceptable to pipe manufacturer.

3.2 **PIPE AND FITTINGS**

A. Place bell or groove end facing upstream.

B. Install gaskets per manufacturer's recommendations.

C. Plug pipeline branches, stubs or other open ends that are not to be immediately connected.

D. Clean interior of pipe of dirt and debris as work progresses.

E. Insulate dissimilar metals from direct contact with each other using neoprene gaskets or asphalt coatings.

F. Meet line and grade tolerance in Section 33 08 00. Use a laser device or demonstrate an equivalent method of establishing line and grade

3.3 **CLEANOUTS AND MANHOLES**

A. Form bottom of excavation clean and smooth to correct elevation.

B. Place structures in location indicated.

C. Install precast units, ASTM C 891.

D. Provide elevations and pipe inverts for inlets and outlets indicated.

E. When structures occur in pavements, mount frame and cover 1/2 inch below finished surface. Provide a concrete cover collar between the

frame and asphalt pavement. Elsewhere set frame and cover three (3) inches above finished grade.

3.4 **INLETS OR CATCH BASINS**

A. Form bottom of excavation clean and smooth to correct elevation.

B. Construct with all connecting piping and appurtenances in their final position.

C. Cut all piping parallel to interior surface wall. Grout connection to provide smooth transition inlet into pipe.

3.5 **SUB DRAIN SYSTEMS**

A. Install pipe and fittings per manufacturer's requirements.

B. Open Joint Systems: Loosely butt pipe ends. Place 12 inches wide filter fabric around pipe circumference, centered over joint.

C. Mechanical Joint Perforated Pipe System: Place pipe with perforations facing down.

D. Place drainage pipe on bed of sewer rock, Section 31 05 13.

3.6 **ABANDONED UTILITIES**

A. Use concrete to plug and cap open ends of abandoned underground utilities that are to remain in place.

B. Provide closures to withstand hydrostatic or earth pressure that may result after ends of abandoned utilities have been closed.

3.7 **TAP CONNECTIONS**

A. Not allowed. Provide a cleanout or manhole structure.

3.8 **COMMISSIONING**

A. Before backfilling, commission pipeline, Section 33 08 00. Provide sizes and types of equipment connections and fittings that match pipe materials when pressure testing system.

B. Provide temporary paved surfaces where trenches pass through roadways, driveways, or sidewalks.

3.9 **CLEANING**

A. Remove debris, concrete, or other extraneous material that accumulates in existing piping or structures.

B. Clean all pipelines after testing. Do not flush sand, gravel, concrete, debris or other materials into existing piping systems.

END OF SECTION

SECTION 33 47 00
PONDS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Clearing pond site and disposal of debris and unsuitable material.

B. Materials for dikes.

1.2 REFERENCES

A. **ASTM Standards**:

D 3282 Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes.

1.3 SUBMITTALS

A. Laboratory analysis and control testing reports of fill to be used in dikes.

B. Sample of geosynthetics to be installed.

C. Quality assurance test results within 24 hours of completed test results.

1.4 PERFORMANCE

A. Protection: Do not contaminate embankment materials with debris or unsuitable material. Protect existing improvements, trees, structures or other items from damage during construction.

B. Dust Control: Section 01 57 00. Prevent dust from being a nuisance to neighborhood, and performance of separate work.

1.5 QUALITY ASSURANCE

A. Perform density tests to assure compacted backfills comply.

B. Do not interrupt surface drainage systems at site without ENGINEER's approval.

C. Control erosion during construction and correct any damage caused by runoff.

PART 2 PRODUCTS

2.1 BACKFILL SOILS

A. Authorized over-excavation fill, Section 31 23 16.

B. Common fill, Section 31 05 13.

C. Aggregate base course, Section 32 11 23.

D. Cement treated fill, Section 31 05 15.

E. Impermeable embankment, ASTM D 3282. A-4, or A-6 material, with a plasticity index of at least 10, and a coefficient of permeability less than 7×10^{-6} cm/sec.

F. Obtain approval of backfill soils to be supplied before beginning construction.

2.2 GEOSYNTHETIC MATERIALS

A. Impermeable, nonbiodegradable sheet material, inert to soil chemicals, resistant to molds, mildew, acids and alkalis, and within a pH range of 3 to 12.

PART 3 EXECUTION

3.1 CONSTRUCTION

A. Remove and stockpile topsoil material for later placement on outer dike surfaces.

B. Excavation, Section 31 23 16.

C. Level areas where dikes are to be constructed.

D. Scarify subgrade 12 inches and compact to 92 percent minimum relative to a standard proctor density, Section 31 23 26.

E. Place embankment materials in lifts consistent with compaction equipment capability. Compact backfill soils to 95 percent or greater relative to a standard proctor. Do not construct embankment with frozen or unapproved material.

F. Shape dikes to the slopes indicated.

3.2 TOLERANCES

A. Dike Surface: Plus or minus 1 inch from true grade.

B. Dike Width: Plus or minus three (3) inches from design dimension.

C. Dike Alignment: Plus or minus six (6) inches from true line.

3.3 FINISHING

A. After dikes have been constructed to lines and grades indicated, spread topsoil on dikes and grade to uniform slope and thickness.

B. Dispose of excess or unsuitable materials and smooth grade all affected areas.

C. Leave site free of debris.

END OF SECTION