STANDARD SPECIFICATIONS
FOR
PUBLIC WORKS
CONSTRUCTION
2020
TABLE OF CONTENTS

CONSTRUCTION SPECIFICATIONS

SECTION 100       SITE PREPARATION
   101   Temporary Erosion and Sediment Controls
   102   Clearing and Grubbing
   103   Pipes, Structures, and Obstructions Removal
   104   Pipes and Structures Abandonment
   105   Pavement Removal, Cold Planing, Reclamation, and Diamond Grinding
   106   Brick or Stone Block Removal
   107   Traffic Signal Removal

SECTION 200       EARTHWORK
   201   Excavation and Embankment
   202   Subgrade Preparation
   203   Fly Ash Stabilization
   204   Flowable Fill
   205   Backfill

SECTION 300       AGGREGATE SURFACE AND BASE COURSES
   301   Aggregate Subbase/Base Course
   302   Aggregate Surface Course
   303   Recycled Asphalt Pavement (RAP) Surface and/or Base Course
   304   Temporary Recycled Portland Cement Concrete (PCC) Surface Course
   305   Perforated Underdrain Pipes

SECTION 400       FLEXIBLE PAVEMENTS
   401   Asphaltic Concrete Pavement

SECTION 500       RIGID PAVEMENT
   501   PCC Pavement
   502   Vertical Curb, Combination Curb and Gutter, and Integral Curb
   503   PCC Sidewalk, PCC Recreational Trail, Mow Strip, and Median Surfacing
   504   PCC Curb Ramp

SECTION 600       STRUCTURAL CONSTRUCTION
   601   PCC Barrier
   602   Sheet Piling
   603   Concrete Box Culverts
   604   Guardrail
   605   Segmental Retaining Walls
   606   Gravity Block Retaining Walls – Large Block
   607   Reinforced PCC Retaining Walls
   608   PCC Stairs
   609   Railings
SECTION 700   SEWER/SUBSURFACE CONSTRUCTION
701   Aggregate Bedding and Trench Stabilization
702   Storm Sewer Pipe, Culverts, Manholes, and Inlets
703   Sanitary Sewer Pipe and Manholes
704   Trenchless Sewer Pipe Installation
705   Water Service Facilities
706   Sewer Pipeline Inspection Using Closed-Circuit Television (CCTV)
707   Sanitary Sewer Force Main Construction

SECTION 800   ROADSIDE IMPROVEMENT AND EROSION CONTROL
801   Topsoil
802   Revegetation
803   Rolled Erosion Control
804   Plant Materials
805   Rock Rip Rap
806   Gabion Baskets and Revet Mattresses
807   Fence

SECTION 900   TRAFFIC CONTROL
901   Foundations, Poles, Mast Arms, and Luminaires
902   Traffic Signals
903   Traffic Signal Controllers
904   Electrical Cable and Duct Installation
905   Pavement Markings
906   Traffic Control Devices
907   Service Disconnects
908   Vehicle Detectors
909   Radar Vehicle Detection System
910   Preemption Control System
911   Traffic Calming Devices

SECTION 1000   MAINTENANCE AND REPAIR
1001   Crack or Joint Repair
1002   Pavement Repair
1003   Brick Pavement Repair
1004   Sewer Repairs
<table>
<thead>
<tr>
<th></th>
<th>MISCELLANEOUS ITEMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1101</td>
<td>Public Information Services</td>
</tr>
<tr>
<td>1102</td>
<td>Sprinkler Systems</td>
</tr>
<tr>
<td>1103</td>
<td>Mailboxes</td>
</tr>
<tr>
<td>1104</td>
<td>Field Office</td>
</tr>
<tr>
<td>1105</td>
<td>Precast Concrete Pavers for Pavement and Sidewalk</td>
</tr>
<tr>
<td>1106</td>
<td>Granite Curb</td>
</tr>
<tr>
<td>1107</td>
<td>Anti-Graffiti Coating</td>
</tr>
<tr>
<td>1108</td>
<td>Equipment Rental</td>
</tr>
<tr>
<td>1109</td>
<td>Mobilization/Demobilization</td>
</tr>
<tr>
<td>1110</td>
<td>Towing</td>
</tr>
</tbody>
</table>
SECTION 100 – SITE PREPARATION

100   Site Preparation

100.01 General

A. Description
   The information, submittal and material requirements, and construction requirements shall apply to all subsections within Section 100 unless otherwise specified. This section includes temporary erosion and sediment controls, site preparation, clearing and grubbing, object removal, abandonment, pavement removal, and traffic signal removal. It is the Contractor’s responsibility to be knowledgeable of and meet the requirements of all applicable permits, including but not limited to the NPDES, SWPPP, Dewatering, Grading, PCSMP, and other applicable permits and/or requirements.

B. Submittal Requirements
   The Contractor shall submit, in accordance with the General Conditions, the following submittals:

1. Approved Disposal Site
   The Contractor shall identify in writing the location(s) of the material disposal site and provide this to the Engineer at the pre-construction meeting. The Contractor shall be responsible for maintaining a log recording the disposal dates, description of material, and approximate amount of material hauled.

2. Adjacent Property Disposal Site
   The Contractor may enter into agreements with adjacent landowners or other persons for the disposal of materials after they have been removed. Any such agreement must be in full compliance with all conditions established in the contract. All such agreements shall be in writing and shall be submitted to the City prior to beginning construction activities. All such agreements shall remain separate of the Contract and shall not relieve the Contractor of any responsibility to comply with the Contract Documents.

3. Qualifications for Certified Arborist

4. Flowable Fill Mix Design shall be in accordance with Section 200

100.02 Material Requirements

A. Backfill Material
   Refer to Section 200 for backfill material requirements.

100.03 Construction Requirements

A. Material Disposal
   Dispose of non-salvaged materials in conformance with the Contract Documents and in accordance with all local, State, and Federal regulations. The Engineer shall resolve any conflicts. The City reserves the right to retain ownership of any materials designated for disposal. Dispose of materials that the City retains ownership of at a location indicated in the Contract Documents or as directed by the Engineer. Obtain all necessary written arrangements with property owners and governmental authorities for disposal locations. The Contractor may enter into agreements with persons regarding the disposal of any material. All such agreements
shall remain separate of the Contract and shall not relieve the Contractor of any responsibility to comply with the Contract Documents.

Do not pile materials within the Right-of-Way of any alley, street, drive, road, walkway, drainage way, or any other public property or the floodplain of any channel unless otherwise allowed by the Contract Documents or authorized in writing by the Engineer. Do not use broken PCC or masonry rubble at the toe of slope and berms, around new piers and culverts, or as stream bank stabilization or rip rap unless directed by the Engineer.

Equipment used for hauling materials to or from the site shall be licensed, insured, and operated in such a manner as to comply with all local, state, and federal requirements, including but not limited to covering the material(s) being hauled.

B. Salvaging Materials

Dismantle and store salvaged materials without damage. Match-mark all individual pieces of the salvaged materials and transport them to the designated location(s). Do not cut, bend, or otherwise damage materials salvaged for the City. Salvage any pipe removed and not reused. Clean such pipe to remove accumulations of dirt and debris. Deliver such pipe to a designated City-owned facility unless otherwise directed by the Engineer. Store salvaged materials at the location(s) designated by the Contract Documents or as directed by the Engineer. Keep salvaged materials free from contamination by dirt or other foreign matter.

C. Dust Control

The Contractor shall be responsible for controlling dust generated from the project site. Dust control methods may include, but not be limited to, applying water or dust palliative and covering active and inactive stockpiles. Dust control shall be performed when soil disturbing activities are being performed, or when directed by the Engineer. Soil disturbing activities include, but are not limited to, earthwork, excavation and trenching, paving, and when vehicles are entering and leaving the job site. Dust control shall be incidental to other items for which the Contract provides direct payment.

D. Street Cleaning

Street cleaning includes removing tracked sediment from the streets and paved surfaces surrounding the site. Street cleaning methods creating dust shall not be allowed. Construction entrances shall be inspected daily for sediment tracking. Visible sediment tracking shall be cleaned and swept at the end of each day, and more frequently if sediment tracking is heavy. Street cleaning shall be incidental to other items for which the Contract provides direct payment.

E. Site Housekeeping

The Contractor shall be responsible for cleaning and removing from the site all excess dirt, trash, debris, excess construction materials, and any other items not part of the final constructed Work. This work shall be incidental to other items for which the Contract provides direct payment, and shall be performed continually throughout the duration of the Work.
101 Temporary Erosion and Sediment Controls

101.01 General

A. Description

This work includes furnishing and constructing temporary erosion and sediment controls including, but is not limited to, silt fence, berms, inlet filters, and other temporary erosion control devices, methods, or necessary appurtenances at the locations indicated in the Contract Documents, as directed by the Engineer, and/or in accordance with City Ordinance 32-105.

For project sites of areas greater than one (1) acre, the Contract Documents shall indicate the requirements for controlling erosion and sediment. For project sites of areas less than one (1) acre, the Contractor shall be responsible for installing temporary controls necessary to prevent erosion and loss of sediment from the site. Unless otherwise indicated in the Contract Documents, the work described within this section shall be the minimum erosion and sediment control measures required for each project site. The Contractor shall be responsible for maintaining the project site to comply with federal, state, and local regulatory requirements for erosion and sediment loss.

Temporary erosion and sediment control measures shall be used to correct conditions that develop during construction; that are needed prior to installation of permanent erosion and sediment control features; or that are needed temporarily to control erosion that develops during normal construction practices but are not associated with permanent control features on the project.

B. Submittal Requirements

Refer to Section 100.01 B for submittal requirements.

101.02 Material Requirements

A. General

Material requirements shall be in accordance with the Contract Documents, in addition to the following requirements.

B. Storm Water Pollution Prevention Plan (SWPPP) Notification Sign

The SWPPP Notification Sign shall be in accordance with Chapter 9 of the Omaha Regional Stormwater Design Manual.

C. Silt Fence Material

Silt fence material shall have a grab strength between ninety (90) to one-hundred twenty-five (125) pounds in accordance with ASTM D4632, Standard Test Method for Grab Breaking Load and Elongation of Geotextiles. Silt fence material shall have a permittivity between five-hundredth (0.05) to ten-hundredth (0.10) per second in accordance with ASTM D4491, Standard Test Methods for Water Permeability of Geotextiles by Permittivity. Silt fence material shall have a minimum ultra-violet (UV) stability of seventy (70) percent after five-hundred (500) hours in accordance with ASTM D4355, Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus.

D. Posts

Posts shall be steel a minimum of forty-eight (48) inches in length, and shall be in accordance with ASTM D6461, Standard Specification for Silt Fence Materials.
E. Wire Staples
Wire staples shall be made of No. 11 gauge steel wire having a minimum length of six (6) inches.

F. Curb and Grate Inlet Filters
Curb and grate inlet filters shall be socks or bags fabricated from porous filter fabric, and shall be selected and sized appropriately for the inlet(s) to be protected. The socks or bags shall be filled with porous gravel, stone, organic, or synthetic media to filter sediment without plugging the inlet(s) to be protected.

G. Geotextile Fabric
Geotextile fabric material shall be in accordance with Section 300.

H. Foundation Rock
Foundation rock material shall be in accordance with Section 700.

I. Temporary Berm Material
Temporary berm material shall be borrow material in accordance with Section 200.

J. Straw Wattles
Straw wattles shall be a minimum of nine (9) inches in diameter and consist of straw-filled tubes made of jute, nylon or other photo-degradable materials. Straw shall be compressed and fungus free, resin free, weed free and free of growth or germination inhibiting substances. Individual tubes shall be twenty (20) to twenty-five (25) feet in length.

101.03 Construction Requirements

A. General
Construction activities shall not commence until all temporary erosion and sediment controls are installed and accepted. Actual site conditions during construction may alter the location or number of temporary erosion and sediment controls necessary. The Engineer reserves the right to alter the location and/or the type of material, and increase or decrease the quantity of the temporary erosion and sediment controls to meet such conditions. Such alterations are not alterations in the details of construction or a change in the scope or character of the work. Coordinate temporary erosion and sediment controls with the installation of permanent erosion and sediment controls to assure economical, effective, and continuous erosion and sediment control throughout the construction period.

Inspect all temporary erosion and sediment controls after each rainfall event of one-half (½) inch or greater. Repair any deficient or damaged controls. Maintenance shall be performed within seven (7) calendar days of identification or before the next rainfall event, whichever occurs first. Remove any accumulated silt or debris as directed by the Engineer. Replace any temporary erosion or sediment control damaged or inadvertently moved during the removal process. Dispose of the removed materials in accordance with Section 100.

Perform any erosion control work resulting from Contractor negligence, carelessness, or failure to construct temporary erosion and sediment controls, or to install permanent controls as a part of the work at no additional cost to the City.

B. SWPPP Notification Sign Installation
The Contractor shall install a post and signage for SWPPP notification at the location(s) indicated in the Contract Documents.
C. Silt Fence Installation
The Contractor shall install silt fence and related materials in accordance with Standard Plate 101-02.

D. Inlet Protection
Inlet protection shall be constructed in a manner that will facilitate cleanout and disposal of trapped sediment, minimize interference with construction activities, and any resultant ponding of storm water will not cause excessive inconvenience or damage to adjacent areas or structures.

1. Curb Inlets
   Place the curb inlet filter in accordance with the manufacturer's recommendations, in such a manner that the filter extends a minimum of one (1) foot beyond the edges of the inlet opening along the gutter line. Remove accumulated material as necessary or as directed by the Engineer.

2. Area Inlets
   Install silt fence in two (2) layers in accordance with the Contract Documents. The distance between the inlet and first layer of silt fence, and between the first and second layer of silt fence, shall be in accordance with the Contract Documents. Remove accumulated material as necessary or as directed by the Engineer.

3. Grate Inlets
   Place the grate inlet filter in accordance with the manufacturer's recommendations and the Contract Documents. Remove accumulated material as necessary or as directed by the Engineer.

E. Construction Entrance
The area of the entrance shall be cleared of all vegetation and excavated a minimum of three (3) inches. Place geotextile fabric in accordance with Section 300, and to cover the full width and length of the entrance. Place and compact foundation rock as indicated in the Contract Documents. The Contractor shall perform compaction efforts using mechanical methods. All surface water flowing or diverted towards construction entrances shall be piped across the entrance or otherwise diverted.

   The SWPPP Notification Sign shall be installed adjacent to the Construction Entrance unless otherwise indicated in the Contract Documents or directed by the Engineer.

F. Temporary Berm Construction
Construct temporary berms at the locations indicated in the Contract Documents or as directed by the Engineer, and in accordance with Section 200. Remove all organic matter from the underlying ground before beginning temporary berm construction. Construction, maintenance, and removal of temporary berms shall be incidental to other items for which the Contract provides direct payment.

   Compact temporary berms in accordance with embankment requirements in Table 200.01. Grade the temporary berm surfaces to be smooth and uniform. The final elevation of temporary berms shall be within three (3) inches of the design elevation.
G. Straw Wattle Installation

The Contractor shall install straw wattles and related materials in accordance with the manufacturer’s recommendations and Standard Plate 101-05 at the locations indicated in the Contract Documents or as directed by the Engineer. Wattles shall be installed perpendicular to runoff flow direction and parallel to the slope contour to intercept water flowing down the slope and trap sediments being moved with the water. Wattles placed along slopes shall not extend across drainage paths.

H. Concrete Washout

The concrete washout shall meet all local, State, and Federal Stormwater quality requirements. The Contractor shall install concrete washouts and related materials in accordance with the manufacturer’s recommendations at the locations indicated in the Contract Documents or as directed by the Engineer. Below grade concrete washouts shall be lined with an impermeable liner with a minimum thickness of ten (10) mils, contain all liquids generated by washout operations, and have a minimum of ten (10) feet by ten (10) feet flat area at the bottom and a minimum of three (3) feet high sloped embankment. Above ground concrete washouts shall be lined with an impermeable liner with a minimum thickness of ten (10) mils, contain all liquids generated by washout operations, and have hay bales used along the perimeter of the facility with the plastic lining wrapped over the top of the hay bales and anchored in place. Commercially manufactured prefabricated containers shall be used and maintained in accordance with the manufacturer’s recommendations and sized to accommodate the liquids generated by washout operations.

I. Maintenance

Remove accumulated material when directed by the Engineer, but no later than when the height of the accumulated material exceeds sixty-five (65) percent of the total height of the temporary erosion and sediment controls. Replace damaged temporary erosion and sediment controls with the same material as originally installed. Temporary erosion and sediment controls damaged by the Contractor’s negligence or carelessness shall be removed and replaced at no additional cost to the City.

Construction entrances shall be maintained in a condition which will prevent tracking or flow of sediment off the site. Maintenance may include periodic top dressing with additional rock, washing and reworking the existing rock, and repair or cleanout of the surface water diversion(s).

J. Removal

Remove temporary erosion and sediment controls, including construction entrances, when directed by the Engineer. Re-grade and re-seed the area disturbed by removing the temporary erosion and sediment controls. Removal and repairing the disturbed area may extend into the warranty period of the project, depending on the rate of growth of plant material for stabilizing the site. Removal and repairing of the disturbed area shall be incidental to items for which the Contract provides direct payment.

101.04 Acceptance

The Engineer shall observe the work to check for compliance with the Contract Documents. Earthwork shall be constructed to the minimum compaction requirements identified in the Contract Documents. The Engineer shall verify the compaction of the earthwork in accordance with the City of Omaha Materials and Testing Manual for Public Works Construction. Any failing tests shall be
excavated, re-compacted, and retested at no additional cost to the City. The limits of the failed area shall be determined by additional testing at intervals determined by the Engineer.

101.05 Measurement and Payment

Temporary berms constructed within the limits of construction, at the end of ditch cut sections, or as indicated in the Contract Documents, are subsidiary to items for which the Contract provides direct payment. Temporary berms shall be constructed, maintained, and removed, as indicated in the Contract Documents.

The Engineer shall measure installation of SWPPP notification signs for payment by each area SWPPP notification sign supplied, installed, and accepted.

The Engineer shall measure installation of silt fences for payment by the linear feet of silt fence supplied, installed, and accepted. Silt fences reinstalled due to damage shall be paid by the linear feet of silt fence supplied, installed, maintained, removed, and accepted. Silt fences reinstalled due to the Contractor’s negligence, carelessness, or convenience shall be incidental to items for which the Contract provides direct payment.

The Engineer shall measure installation of area inlet protections for payment by each area inlet protection supplied, installed, and accepted.

The Engineer shall measure installation of curb inlet protections for payment by each curb inlet protection supplied, installed, and accepted.

The Engineer shall measure installation of grate inlet protections for payment by each grate inlet protection supplied, installed, and accepted.

The Engineer shall measure installation of construction entrances for payment by each construction entrance supplied, installed, and accepted.

The Engineer shall measure installation of straw wattles for payment by the linear feet of straw wattle supplied, installed, and accepted. Straw wattles reinstalled due to the Contractor’s negligence, carelessness, or convenience shall be incidental to items for which the Contract provides direct payment.

The Engineer shall measure installation of concrete washouts for payment by each concrete washout supplied, installed, and accepted.

The Engineer shall measure maintenance of SWPPP notification signs for payment by each SWPPP notification sign maintained and accepted.

The Engineer shall measure maintenance of silt fences for payment by the linear feet of silt fence maintained and accepted. Silt fences maintained due to the Contractor’s negligence, carelessness, or convenience shall be incidental to items for which the Contract provides direct payment.

The Engineer shall measure maintenance of area inlet protections for payment by each area inlet protection maintained and accepted.

The Engineer shall measure maintenance of curb inlet protections for payment by each curb inlet protection maintained and accepted.

The Engineer shall measure maintenance of grate inlet protections for payment by each grate inlet protection maintained and accepted.

The Engineer shall measure maintenance of construction entrances for payment by each construction entrance maintained and accepted.
The Engineer shall measure maintenance of straw wattles for payment by the linear feet of straw wattle maintained and accepted. Straw wattles maintained due to the Contractor’s negligence, carelessness, or convenience shall be incidental to items for which the Contract provides direct payment.

The Engineer shall measure maintenance of concrete washouts for payment by each concrete washout maintained and accepted.

The Engineer shall measure removal of SWPPP notification signs for payment by each SWPPP notification sign removed and accepted.

The Engineer shall measure removal of silt fences for payment by the linear feet of silt fence removed and accepted.

The Engineer shall measure removal of area inlet protections for payment by each area inlet protection removed and accepted.

The Engineer shall measure removal of curb inlet protections for payment by each curb inlet protection removed and accepted.

The Engineer shall measure removal of grate inlet protections for payment by each grate inlet protection removed and accepted.

The Engineer shall measure removal of construction entrances for payment by each construction entrance removed and accepted.

The Engineer shall measure removal of straw wattles for payment by the linear feet of straw wattle removed and accepted.

The Engineer shall measure removal of concrete washouts for payment by each concrete washout removed and accepted.

Payment shall be made under the following unless otherwise indicated in the Contract Documents. The Contract Price shall be full compensation for supplying and installing all silt fence, berms, filters, stakes, binding materials, and for furnishing all labor, materials, equipment, tools, and all incidentals necessary to complete the work.
<table>
<thead>
<tr>
<th><strong>Description</strong></th>
<th><strong>Unit</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Install SWPPP Notification Sign</td>
<td>Each</td>
</tr>
<tr>
<td>Install Silt Fence</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Install Area Inlet Protection</td>
<td>Each</td>
</tr>
<tr>
<td>Install Curb Inlet Protection</td>
<td>Each</td>
</tr>
<tr>
<td>Install Grate Inlet Protection</td>
<td>Each</td>
</tr>
<tr>
<td>Install Construction Entrance</td>
<td>Each</td>
</tr>
<tr>
<td>Install Straw Wattle</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Install Concrete Washout</td>
<td>Each</td>
</tr>
<tr>
<td>Maintain SWPPP Notification Sign</td>
<td>Each</td>
</tr>
<tr>
<td>Maintain Silt Fence</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Maintain Area Inlet Protection</td>
<td>Each</td>
</tr>
<tr>
<td>Maintain Curb Inlet Protection</td>
<td>Each</td>
</tr>
<tr>
<td>Maintain Grate Inlet Protection</td>
<td>Each</td>
</tr>
<tr>
<td>Maintain Construction Entrance</td>
<td>Each</td>
</tr>
<tr>
<td>Maintain Straw Wattle</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Maintain Concrete Washout</td>
<td>Each</td>
</tr>
<tr>
<td>Remove SWPPP Notification Sign</td>
<td>Each</td>
</tr>
<tr>
<td>Remove Silt Fence</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Remove Area Inlet Protection</td>
<td>Each</td>
</tr>
<tr>
<td>Remove Curb Inlet Protection</td>
<td>Each</td>
</tr>
<tr>
<td>Remove Grate Inlet Protection</td>
<td>Each</td>
</tr>
<tr>
<td>Remove Construction Entrance</td>
<td>Each</td>
</tr>
<tr>
<td>Remove Straw Wattle</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Remove Concrete Washout</td>
<td>Each</td>
</tr>
</tbody>
</table>
102 Clearing and Grubbing

102.01 General

A. Description

This work includes clearing the limits of construction as defined in the Contract Documents, to the extent necessary for the construction of the project. Remove and dispose of all stumps, dead trees, logs, down timber, brush, other herbaceous vegetation, rubbish or trash, and unwanted materials from within the limits of construction. Do not remove live trees, hedge, shrubs, or grass beyond the limits of construction, except as indicated in the Contract Documents or as directed by the Engineer.

General clearing and grubbing shall consist of the removal and disposal of wire and/or board fences, all trees with diameters of nine (9) inches or less and stumps with diameters of twelve (12) inches or less, all other objectionable material such as logs and down timber, shrubs, hedges, brush, weeds, grass, other herbaceous vegetation, and rubbish or trash encountered within the limits of construction, other areas indicated in the Contract Documents or as directed by the Engineer. All living trees or shrubs located outside the limits of construction shall not be removed, injured or destroyed.

Clearing and grubbing of intersection corners shall include removal of stumps, trees, landscaping, reinforcing steel, and all other items necessary to construct the proposed improvements and to match the existing elevations.

Clearing and grubbing trees shall consist of the removal and disposal of trees over nine (9) inches in diameter, including the stumps of such trees and the large roots.

Grubbing stumps shall consist of the removal and disposal of stumps over twelve (12) inches in diameter and the large roots of such stumps, where the tree has been removed by others.

During the primary nesting season of migratory birds and bats, an initial survey of nesting birds and bats within the project area shall be conducted by a qualified biologist and paid for separately by the Owner. Clearing and grubbing activities within the surveyed area shall be completed within three (3) days of the survey, unless otherwise directed by the Engineer. No additional compensation, other than time extensions if warranted, will be allowed due to delays or inconvenience because of the migratory bird and bat survey. Any additional surveys required beyond the initial survey shall be conducted at no additional to the Owner.

B. Submittal Requirements

Refer to Section 100.01 B for submittal requirements.

102.02 Material Requirements

A. General

Refer to Section 100.02 for general material requirements.

102.03 Construction Requirements

A. General

Refer to Section 100.03 for general construction requirements, in addition to the following requirements. General clearing and grubbing shall be performed within the limits of construction using proper equipment, to clear all objects for which the Contract does not provide direct payment. The Contractor shall review each intersection corner which is
designated for clearing and grubbing in the Contract Documents. The Contractor shall determine the extent of clearing and grubbing that will be required at each intersection corner. The Contractor shall clear and grub an area sufficient to perform the work and shall match the existing ground conditions at the limits of clearing and grubbing unless otherwise indicated in the Contract Documents.

B. Object Removal

Remove and dispose of all objects, trees, stumps, roots, and other obstructions to a minimum depth of two (2) feet below finished grade elevation. Use of a mechanical stump chipper is acceptable but not required for accomplishing stump removal. Removal of stumps more than three (3) feet below finished grade in embankment areas is not required. Cut such stumps flush or below the existing ground prior to embankment construction.

Perform all required clearing and grubbing activities before beginning excavation, grading, or embankment operations. Maintain adequate drainage in all areas. Conduct all operations without disturbing any materials, equipment, or structures outside the limits of construction.

Disturbed ground shall be compacted in accordance with Section 200.

C. Object Preservation

Preserve trees, shrubs, plants, and other objects that are to remain within established limits indicated in the Contract Documents or as directed by the Engineer. A certified Arborist shall supervise all tree and root trimming operations. Remove low-hanging and unsound branches from remaining trees or shrubs using proper practices to trim tree branches and roots. Trim branches of trees extending over the roadbed to provide a clear height of at least fifteen (15) feet. Treat cut or scarred tree or shrub surfaces with an asphaltum-based paint manufactured for tree surgery.

Unless otherwise indicated in the Contract Documents, trees within the limits of construction shall be protected in accordance with the City’s Ordinances.

102.04 Acceptance

The Engineer shall observe the work to check for compliance with the Contract Documents. Backfill shall be constructed to the minimum compaction requirements identified in the Contract Documents. The Engineer shall verify the compaction of the backfill in accordance with the City of Omaha Materials and Testing Manual for Public Works Construction.

102.05 Measurement and Payment

The Engineer shall measure general clearing and grubbing for payment by a lump sum of work performed and accepted. Progress payments shall be made as a percentage of the overall area of completed clearing and grubbing as determined by the Engineer.

The Engineer shall measure clearing and grubbing per intersection corner for payment by each intersection corner of work performed and accepted. This item will be measured only once for each intersection corner regardless of the number of times an area is cleared and grubbed.

The Engineer shall measure clearing and grubbing of trees for payment by the size of each tree, within a defined diameter range, removed and accepted. The Engineer shall determine the diameter by measuring the circumference two (2) feet above the surrounding ground and dividing this measured circumference by 3.14.
The Engineer shall measure grubbing of stumps for payment by the size of each stump, within a defined diameter range, removed and accepted. The Engineer shall determine the diameter by measuring the circumference two (2) feet above the surrounding ground and dividing this measured circumference by pi (3.14).

The Engineer shall measure trimming of tree branches for payment by the labor-hours, excluding the first two (2) hours, of tree branch trimming performed and accepted.

The Engineer shall measure trimming of tree roots for payment by the labor-hours, excluding the first two (2) hours, of tree root trimming performed and accepted.

Tree and root trimming to obtain the necessary clearances that requires less than two (2) labor-hours is subsidiary to items that the Contract provides direct payment.

The Engineer shall measure protection of trees for payment by each tree protected and accepted.

Payment shall be made under the following unless otherwise indicated in the Contract Documents. The Contract Price shall be full compensation for removal and disposal of vegetation, trees, stumps, and all other objectionable or unwanted material, backfilling, compacting, and for furnishing all labor, materials, equipment, tools, and all incidentals necessary to complete the work.

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clearing and Grubbing – General</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>Clearing and Grubbing – Per Intersection Corner</td>
<td>Each</td>
</tr>
<tr>
<td>Clearing and Grubbing Trees Over ___ to ___ Diameter</td>
<td>Each</td>
</tr>
<tr>
<td>Clearing and Grubbing Trees Over ___ Diameter</td>
<td>Each</td>
</tr>
<tr>
<td>Grubbing Stumps Over ___ to ___ Diameter</td>
<td>Each</td>
</tr>
<tr>
<td>Grubbing Stumps Over ___ Diameter</td>
<td>Each</td>
</tr>
<tr>
<td>Trim Tree Branch</td>
<td>Labor-Hour</td>
</tr>
<tr>
<td>Trim Tree Root</td>
<td>Labor-Hour</td>
</tr>
<tr>
<td>Protect Tree</td>
<td>Each</td>
</tr>
</tbody>
</table>
103 Pipes, Structures, and Obstructions Removal

103.01 General

A. Description
This work includes removing, salvaging, backfilling, and/or disposing of sewer pipes, utility mains, manholes, inlets, railroad and streetcar rails and ties, guardrail, retaining walls, fences, headwalls, culverts, flared end sections of pipe, pipe supports, structures, steps and clearing of tracts as indicated in the Contract Documents or as directed by the Engineer.

B. Submittal Requirements
Refer to Section 100.01 B for submittal requirements.

103.02 Material Requirements

A. General
Refer to Section 100.02 for general material requirements.

103.03 Construction Requirements

A. General
Refer to Section 100.03 for general construction requirements, in addition to the following requirements. If identified in the Contract Documents for removal, remove each pipe, structure, and obstruction completely. Backfill and compact the resulting voids and cavities in accordance with Section 200. Unless otherwise indicated in the Contract Documents, the unit price bid for the removal of existing structures will include all right and title to the structure removed.

B. Pipe Removal
Remove pipes completely or as indicated in the Contract Documents. Excavate as necessary to accomplish the required removals and properly dispose of the removed materials. Backfill and compact the resulting voids and cavities in accordance with Section 200. If portions of pipes are to remain in place, abandon in accordance with Section 104.

C. Abandoned Utility Removal
Remove abandoned utilities completely or as indicated in the Contract Documents. Excavate as necessary to accomplish the required removals and properly dispose of the removed materials. Construct a pipe plug in accordance with Standard Plate 700-03. Pipe plug shall be incidental to other items for which direct payment is made. Backfill and compact the resulting voids and cavities in accordance with Section 200. The Contractor shall verify and coordinate removal of abandoned utilities with the local Utility Company before commencing work of this nature.

D. Structure and Obstruction Removal
Remove structures or obstructions completely or as indicated in the Contract Documents. Excavate as necessary to accomplish the required removals. If portions of structures or obstructions are to remain in place, the Contractor shall saw cut a true line to separate the portions. Backfill and compact the resulting voids and cavities in accordance with Section 200.

If indicated in the Contract Documents for partial removal, or as directed by the Engineer, remove and salvage, or dispose of structures or obstructions to the horizontal limits and a minimum depth of three (3) foot below the existing ground or finished grade in excavation areas. Reface the discontinued end of an existing retaining wall left in place to match the original construction as nearly as possible.
Remove only the portions of structures indicated in the Contract Documents or those that interfere with the new construction when the Contract Documents provide for using any part of an existing structure in a new structure. Cut or chip and trim the connecting edges of the existing structure to the required lines and grades, without weakening or damaging that part of the retained structure.

E. Tract Clearing
Accomplish clearing of tracts by removing all foundations, basement walls, piling, driveways, walks, and other miscellaneous items encountered within the limits of the specific tract and disposing of all materials encountered in the work. Removal of walkway surfacing other than Portland cement concrete (PCC), brick, stone block, and asphaltic concrete pavement (ACP) is subsidiary to items for which the Contract provides direct payment. Remove basement walls and piling and all other miscellaneous removals encountered to a minimum depth of three (3) feet below finished grade elevation, or as directed by Engineer.

Contact the Metropolitan Utilities District to arrange for the gas service to be shut off. Disconnect all sewers and utilities encountered. Plug sewer service lines at the property line by constructing a pipe plug in accordance with Standard Plate 700-03. Remove all sewer service lines between the structure and the property line. Shut-off water service valves at the water main before abandoning.

The City reserves the right to sell and remove buildings from tracts before the commencement of work. If buildings are sold and removed from the tract prior to commencement, the City reserves the right to delete the bid item for removing the building and replace it with a bid item for the clearing of the tract. The City reserves the right to salvage valuable or reusable items such as doors, windows, and fixtures from buildings before the commencement of work.

F. Removal in Channels
Remove all bridges, culverts, or other drainage structures within the channel to the natural channel bottom or as directed by the Engineer. Remove portions of the drainage structure located outside the natural channel bottom to one (1) foot below the surface of the existing ground. Completely remove all steel and timber superstructures, substructures, and the top slabs and decks of all abandoned PCC and masonry bridges and culverts. Remove PCC and masonry abutments and walls to a minimum of two (2) feet below the subgrade, surface of slopes, or existing ground. Remove piers to the elevation of the streambed. Cut or drive piles two (2) feet below the finished grade in all areas except running streams. Cut piles to the elevation of the streambed in all running streams.

Do not use concrete or masonry rubble at the toe of slopes or berms, around new piers or culverts, as a stream bank anchor, or as rip rap, without written approval from the Engineer. Process all approved materials broken for use as rip rap to sizes less than one hundred fifty (150) pounds.

Backfill and compact the resulting voids and cavities in accordance with Section 200.

The Contractor may place rocks, broken concrete, or other solid materials less than six (6) inches in size in backfill areas other than those designated for placing or driving piling when approved in writing by the Engineer. Cover rocks, broken PCC, or other solid materials with at least two (2) feet of backfill material in accordance with Section 200.
G. **Permanent Fixture Removal**

Removal of fence, light poles, signs, guardrail, mailbox, flagpole or other fixtures shall include removal of associated footings, posts, and all parts and materials to provide full and complete removal. Disconnect electrical service to fixtures or light poles prior to removal. Items designated for salvage shall be cleaned and delivered to the City. Mailboxes designated for salvage shall be cleaned and delivered to the United States Postal Service or the property owner.

H. **Remove and Reset Guardrail**

Remove and reset guardrail as indicated in the Contract Documents. Cable removed and to be reset shall be rolled on spools, and the length of cable on each spool shall not exceed two thousand (2,000) feet. Salvaged material and hardware designated for resetting shall be stored securely. The Contractor shall replace all existing materials damaged during removal at no additional cost to the City. All materials that the Engineer determines are not salvageable or needed by the City shall become property of the Contractor. The Contractor shall remove all non-salvageable material from the project site and dispose these materials in accordance with all applicable laws and regulations. The Contractor shall reset the guardrail at the locations indicated in the Contract Documents. End posts may be reset if the eight (8) inch by eight (8) inch by one-fourth (¼) inch plate is removed from the bottom of the post and a support bracket is installed on the post at the ground line. Extra line posts may be converted to end posts by removing hook bolts and installing an end post cap and a support bracket as indicated in the Contract Documents.

I. **Remove and Relocate Fence**

Remove and relocate fence shall be defined as removing and reinstalling in a different location as indicated in the Contract Documents. Salvage material in the existing fence and incorporate the material into the relocated fence. Store the salvaged materials until relocation in a safe and secure manner. Relocate to meet provisions for setting new fence as applicable. When posts are set in concrete, remove concrete from old posts and reset in new concrete. Replace fence material damaged beyond re-use. Payment for replacing non-reusable items shall be for material only based on invoiced cost; labor shall be incidental to items for which the Contract provides direct payment. Space the posts and attach fencing to the posts to match the original fence. Furnish and use new material to fasten members or wires to posts as necessary. New fastening materials are incidental to items for which the Contract provides direct payment.

J. **Remove and Reinstall Fence**

Remove and reinstall fence shall be defined as removing and reinstalling in the same location as indicated in the Contract Documents. Salvage material in the existing fence and incorporate the material into the reinstalled fence. Store the salvaged materials until reinstallation in a safe and secure manner. Reinstall to meet provisions for setting new fence as applicable. When posts are set in concrete, remove concrete from old posts and reset in new concrete. Replace fence material damaged beyond re-use. Payment for replacing non-reusable items shall be for material only based on invoiced cost; labor shall be incidental to items for which the Contract provides direct payment. Space the posts and attach fencing to the posts to match the original fence. Furnish and use new material to fasten members or wires to posts as necessary. New fastening materials are incidental to items for which the Contract provides direct payment.
K. **Remove Rip Rap**

Remove rip rap completely or as indicated in the Contract Documents. Excavate as necessary to accomplish the required removals. Backfill and compact the resulting void in accordance with Section 200.

L. **Remove and Reset Retaining Wall**

Remove existing retaining walls completely or as indicated in the Contract Documents. Excavate as necessary to accomplish the required removals. Reset the retaining wall in accordance with Section 600 at locations indicated in the Contract Documents. Removal and resetting of below ground components, including footings, shall be considered subsidiary to items for which the Contract provides direct payment.

M. **Remove and Salvage Stone Curb**

Remove existing stone curb completely or as indicated in the Contract Documents and in such a manner as to salvage the maximum number of pieces for cleaning and reuse. Excavate as necessary to accomplish the required removals. The City shall retain ownership of the stone pieces. The Contractor shall clean, sort, and stack on pallets the salvaged pieces and deliver to the Public Works Joint Use Facility located at 1810 Jaynes Street. Any materials not designated for salvage, and any unsalvageable materials, will become property of the Contractor and shall be properly disposed of in accordance with Section 100. Removal of below ground components, including footings, shall be considered subsidiary to items for which the Contract provides direct payment.

103.04 **Acceptance**

The Engineer shall observe the work to check for compliance with the Contract Documents. Backfill shall be constructed to the minimum compaction requirements identified in the Contract Documents. The Engineer shall verify the compaction of the backfill in accordance with the City of Omaha Materials and Testing Manual for Public Works Construction.

103.05 **Measurement and Payment**

The Engineer shall measure the removal of structures or obstructions by the structure or obstruction units indicated below, and shall be removed, salvaged or disposed of, and accepted. Salvaging of valuable or reusable items by the City shall not eliminate the bid item for removing the structure or obstruction. Excavation for removal and backfilling of any cavities or trenches created by such removal shall be subsidiary to items for which the Contract provides direct payment.

The Engineer shall measure clearing of tracts for payment by a lump sum of tract cleared, backfilled, and accepted.

The Engineer shall measure removal of sewer pipes for payment by the linear feet of the size of sewer pipe removed, backfilled, and disposed of, or salvaged, cleaned, delivered, and accepted.

The Engineer shall measure removal of culvert pipes for payment by the linear feet of the size of culvert pipe removed, backfilled, and disposed of, or salvaged, cleaned, delivered, and accepted.

The Engineer shall measure removal of manholes for payment by each manhole removed, backfilled, disposed of, and accepted.

The Engineer shall measure removal of inlets for payment by the type of each inlet removed, backfilled, disposed of, and accepted.
The Engineer shall measure removal of flared end sections for payment by the size of each flared end section removed, backfilled, disposed of, and accepted.

The Engineer shall measure removal of headwalls for payment by each headwall removed, backfilled, disposed of, and accepted.

The Engineer shall measure removal of pipe supports for payment by each pipe support removed, backfilled, disposed of, and accepted.

The Engineer shall measure removal of abandoned utilities for payment by the linear feet of utility removed, backfilled, and disposed of, or salvaged, cleaned, delivered, and accepted.

The Engineer shall measure removal of steps for payment by each flight of steps removed, backfilled, disposed of, and accepted. Individual steps shall not be counted, but the entire flight of steps shall be considered a single unit, unless otherwise indicated in the Contract Documents.

The Engineer shall measure removal of retaining walls for payment by the square feet of the type of initially exposed surface of wall removed, backfilled, disposed of, and accepted. Removal of additional materials and footings below the initial exposed surface shall be subsidiary to items for which the Contract provides direct payment.

The Engineer shall measure removal and resetting of retaining walls for payment by the square feet of the type of initially exposed surface of retaining wall removed, backfilled, salvaged, cleaned, reset in the location indicated in the Contract Documents, and accepted. Removal and resetting of additional materials and footings below the initial exposed surface shall be subsidiary to items for which the Contract provides direct payment.

The Engineer shall measure removal of streetcar rails or railroad rails for payment by the linear feet of rail removed, backfilled, and disposed of, or salvaged, cleaned, delivered, and accepted.

The Engineer shall measure removal of streetcar ties or railroad ties for payment by each tie removed, backfilled, disposed of, and accepted.

The Engineer shall measure removal of guardrails and posts for payment by the linear feet of guardrail removed, backfilled, and disposed of, or salvaged, cleaned, delivered, and accepted. The Engineer shall conduct measurements from center to center of end posts and shall not include the distance of the section of beam elements or terminal sections projecting beyond these limits. Removal of such projections shall be subsidiary to items for which the Contract provides direct payment.

The Engineer shall measure removal and resetting guardrails and posts for payment by the linear feet of guardrail removed, reset, and accepted. The Engineer shall conduct measurements from center to center of end posts and shall not include the distance of the section of beam element projecting beyond these limits. Removal and resetting of such projections shall be subsidiary to items for which the Contract provides direct payment. Any new posts, offset blocks, hardware, and incidentals required to reset the guardrail shall be subsidiary to items for which the Contract provides direct payment.

The Engineer shall measure removal of fences for payment by the linear feet of fence removed, backfilled, disposed of, and accepted. Removal of posts, post footings, and other associated objects shall be subsidiary to items for which the Contract provides direct payment.

The Engineer shall measure removal and relocation of fences for payment by the linear feet of fence removed, backfilled, salvaged, cleaned, installed in a different location, and accepted. Removal and relocation of posts, post footings, and other associated objects shall be subsidiary to items for which
the Contract provides direct payment. Payment for replacing non-reusable items shall only be for material based on submitted invoiced costs; labor shall be incidental to items for which the Contract provides direct payment.

The Engineer shall measure removal and reinstallation of fences for payment by the linear feet of fence removed, backfilled, salvaged, cleaned, reinstalled in the same location, and accepted. Removal and reinstallation of posts, post footings, and other associated objects shall be subsidiary to items for which the Contract provides direct payment. Payment for replacing non-reusable items shall only be for material based on submitted invoiced costs; labor shall be incidental to items for which the Contract provides direct payment.

The Engineer shall measure removal of yard lights, signs and other permanent improvements for payment as defined by the Contract Documents. Removal of such items shall include removing, backfilling, and disposing of all posts, materials, and appurtenances associated with each item of removal.

The Engineer shall measure removal and salvaging of yard lights, signs and other permanent improvements for payment as defined by the Contract Documents. Removal and salvaging of such items shall include removing, backfilling, and salvaging of all posts, materials, and appurtenances associated with each item of removal. The salvaged item shall be returned to the property owner or the City, as indicated in the Contract Documents.

The Engineer shall measure removal and reinstallation of yard lights, signs and other permanent improvements for payment as defined by the Contract Documents. Removal and reinstallation of such items shall include removing, backfilling, and reinstalling all posts, materials, and appurtenances associated with each item of removal and reinstallation.

The Engineer shall measure removal and relocation of yard lights, signs and other permanent improvements for payment as defined by the Contract Documents. Removal of such items shall include removing, backfilling, and relocating all posts, materials, and appurtenances associated with each item of removal and relocation.

The Engineer shall measure removal of rip rap for payment by the cubic yards of rip rap removed, backfilled, disposed of, and accepted. The Engineer shall measure the volume of rip rap to be removed in its original position by the method of average end areas. The Engineer reserves the right to verify the rip rap removal quantity by cross-sections or topographic survey.

The Engineer shall measure removal and salvaging of stone curbs for payment by the linear feet of stone curb removed, backfilled, cleaned, sorted, stacked on pallet(s), delivered to the City, and accepted. The salvaged item shall be returned to the City, unless otherwise indicated in the Contract Documents.

Payment shall be made under the following unless otherwise indicated in the Contract Documents. The Contract Price shall be full compensation for removing, salvaging and storing, and/or disposing of sewer pipes, utility mains, manholes, inlets, railroad and streetcar rails and ties, buildings, guardrail, retaining walls, fences, headwalls, culverts, flared end sections of pipes, pipe supports, structures, steps, clearing of tracts, surplus material, and all miscellaneous material encountered; excavation; backfilling; and for furnishing all labor, materials, equipment, tools and all incidentals required to complete the work. Unless otherwise indicated in the Contract Documents, the Contract Price shall include all right and title to the structures or obstructions removed.
<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clear Tract</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>Remove ___ or Smaller Sewer Pipe</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Remove ___ to ___ Sewer Pipe</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Remove ___ Sewer Pipe</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Remove ___ or Smaller Culvert Pipe</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Remove Culvert Pipe Over ___ to ___</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Remove ___ Culvert Pipe</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Remove Manhole</td>
<td>Each</td>
</tr>
<tr>
<td>Remove ___ Inlet</td>
<td>Each</td>
</tr>
<tr>
<td>Remove Flared End Section (less than ___)</td>
<td>Each</td>
</tr>
<tr>
<td>Remove Flared End Section (___ to ___)</td>
<td>Each</td>
</tr>
<tr>
<td>Remove Flared End Section over ___ to ___</td>
<td>Each</td>
</tr>
<tr>
<td>Remove Headwall</td>
<td>Each</td>
</tr>
<tr>
<td>Remove Pipe Support</td>
<td>Each</td>
</tr>
<tr>
<td>Remove Abandoned Utility</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Remove Steps</td>
<td>Each</td>
</tr>
<tr>
<td>Remove Concrete Retaining Wall</td>
<td>Square Foot</td>
</tr>
<tr>
<td>Remove Rip-Rap Retaining Wall</td>
<td>Square Foot</td>
</tr>
<tr>
<td>Remove and Reset Retaining Wall</td>
<td>Square Foot</td>
</tr>
<tr>
<td>Remove Railroad Rail</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Remove Streetcar Rail</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Remove Railroad Ties</td>
<td>Each</td>
</tr>
<tr>
<td>Remove Streetcar Ties</td>
<td>Each</td>
</tr>
<tr>
<td>Remove Guardrail</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Remove and Reset Guardrail</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Remove Fence</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Remove and Relocate Fence</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Remove and Reinstall Fence</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Remove ___</td>
<td>Each</td>
</tr>
<tr>
<td>Remove and Salvage _________</td>
<td>Each</td>
</tr>
<tr>
<td>Remove and Reinstall _________</td>
<td>Each</td>
</tr>
<tr>
<td>Remove and Relocate _________</td>
<td>Each</td>
</tr>
<tr>
<td>Remove Rip Rap</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>Remove and Salvage Stone Curb</td>
<td>Linear Foot</td>
</tr>
</tbody>
</table>
104 Pipes and Structures Abandonment

104.01 General

A. Description

This work includes abandonment of existing manholes, inlets, discharge structures, sewer pipe, and utility mains. Abandonment includes removing the cover and top, breaking down the walls to an elevation a minimum of three (3) feet below the surrounding ground or finished grade elevation, plugging all sewer openings with a plug in accordance with Section 700, breaking up the floor of the structure into pieces, filling the opening, and backfilling.

B. Submittal Requirements

Refer to Section 100.01 B for submittal requirements.

104.02 Material Requirements

A. General

Refer to Section 100.02 for general material requirements, in addition to the following requirements.

B. Sand Gravel Fill

Sand and Gravel for filling abandoned structures shall be in accordance with the Contract Documents, or be similar in gradation and material properties to Nebraska Department of Roads Class B aggregate. Material delivery tickets shall be submitted.

C. Flowable Fill

Flowable Fill shall be in accordance with Section 200.

D. Portland Cement Concrete

PCC shall be in accordance with Section 500.

104.03 Construction Requirements

A. General

Refer to Section 100.03 for general construction requirements, in addition to the following requirements.

B. Sewer Pipe Abandonment

Excavate as necessary to expose the upstream and downstream ends of the pipe to be abandoned. Construct a pipe plug on the downstream end in accordance with Standard Plate 700-03. All sewer pipes beneath pavement shall be filled with flowable fill unless otherwise indicated in the Contract Documents or as directed by the Engineer. The pipe shall be completely filled and the quantity of flowable fill necessary shall be estimated in advance to equal the volume of the inside of the pipe for its full length between the pipe plugs. Construct a pipe plug on the upstream end in accordance with Standard Plate 700-03 and Section 700. Multiple pipe access locations may be required to completely fill the pipe. Backfill shall be in accordance with Section 200. Sanitary sewer services shall be abandoned by constructing a pipe plug in accordance with Standard Plate 700-03 and Section 700.

C. Structure Abandonment

Remove the upper portion of the structure to a minimum of three (3) feet below the proposed finished elevation of the surrounding ground. Remove all rubble and debris from the remaining
portion of the structure. Place flowable fill or sand and gravel fill material in the portions of the structures to remain, as follows:

1. **Beneath Pavement**
   
   All structures abandoned beneath pavement shall be filled with flowable fill in accordance with Section 200. The structure shall be completely filled and the quantity of flowable fill required to fill the structure shall be determined in advance to equal the volume of the inside of the structure.

2. **Outside Pavement**
   
   All structures abandoned outside pavement shall be filled with sand gravel fill material in accordance with this Section, or as directed by the Engineer.

   Backfill abandoned structures in accordance with Section 200. Salvaging of manhole rings and covers, frames, grates, or other materials shall be as required by the Contract Documents or as directed by the Engineer.

D. **Utility Main Abandonment**

Utilities to be abandoned shall include all water mains and gas mains, and other utilities as required by the Contract Documents or as directed by the Engineer. Construct a pipe plug on the downstream end in accordance with Standard Plate 700-03 and Section 700. All mains beneath pavement shall be filled with flowable fill, unless otherwise indicated in the Contract Documents or as directed by the Engineer. Construct a pipe plug on the upstream end in accordance with Standard Plate 700-03 and Section 700. Backfill shall be in accordance with Section 200.

104.04 **Acceptance**

The Engineer shall observe the work to check for compliance with the Contract Documents. Backfill shall be constructed to the minimum compaction requirements identified in the Contract Documents. The Engineer shall verify the compaction of the backfill in accordance with the City of Omaha Materials and Testing Manual for Public Works Construction.

104.05 **Measurement and Payment**

Excavation for sewer pipe, utility main, and/or structure abandonment and backfilling of any cavities or trenches created by the removal or abandonment of a sewer pipe, utility main, and structure shall be subsidiary to items for which the Contract provides direct payment.

The Engineer shall measure abandoning structures for payment by the type of each structure abandoned, backfilled, and accepted. Furnishing and placing flowable fill or sand and gravel fill material shall be incidental to items for which the Contract provides direct payment.

The Engineer shall measure abandoning sewer pipes for payment by the cubic yards of flowable fill placed to fill the pipe and accepted. The Contractor shall submit flowable fill material delivery tickets to the Engineer.

The Engineer shall measure utility main abandonment for payment by the cubic yards of flowable fill placed to fill the main and accepted. The Contractor shall submit flowable fill material delivery tickets to the Engineer.

The Engineer shall measure pipe plugs for payment by the size of each pipe plug constructed and accepted.
Payment shall be made under the following unless otherwise indicated in the Contract Documents. The Contract Price shall be full compensation for removing and disposing of, or salvaging and delivering all materials; breaking floors; excavation; furnishing and placing fill material for abandonment; furnishing, placing and compacting backfill material; and for furnishing all labor, materials, equipment, tools, and all incidentals necessary to complete the work.

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abandon ____</td>
<td>Each</td>
</tr>
<tr>
<td>Abandon ____ Pipe</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>Abandon ____ Main</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>Construct ____” Pipe Plug</td>
<td>Each</td>
</tr>
</tbody>
</table>
105  Pavement Removal, Cold Planing, Reclamation, and Diamond Grinding

105.01 General
   A. Description
      This work includes full depth removal of existing driveways, walkways, pavement, pavement surfacing, headers, curb and gutter, or curb, including salvaging or disposing of the materials and all necessary excavation and backfilling.
      
      Cold planing shall consist of milling the existing PCC and/or AC pavement as indicated in the Contract Documents or as directed by the Engineer.
      
      Reclamation shall consist of full depth in-place pulverization and blending of the existing pavement along with a portion of the underlying base material, and preparation of the newly pulverized and blended material to construct a new sub-base.
      
      Diamond grinding shall consist of grinding or planing the existing PCC and/or AC pavement with diamond blades to remove any surface irregularities to within a specified limit as indicated in the Contract Documents or as directed by the Engineer.
      
      Combination curb and gutter is defined as any concrete curb and gutter section whose combined total width is greater than one (1) foot but not more than three (3) feet and is not constructed integrally with an adjoining base or pavement. Combination curb and gutter with a combined total width greater than three (3) feet shall be classified as pavement. Curb removal is defined as a curb consisting of concrete or other type of material, such as granite or sandstone, with a width less than or equal to one (1) foot.

   B. Submittal Requirements
      Refer to Section 100.01 B for submittal requirements.

105.02 Material Requirements
   A. General
      Refer to Section 100.02 for general material requirements.

105.03 Construction Requirements
   A. General
      Refer to Section 100.03 for general construction requirements, in addition to the following requirements. All equipment, tools, and machinery shall be of adequate capacity for the intended purpose which it is used. Maintain equipment, tools, and machinery in working condition at all times. The Contractor is responsible for controlling any dust generated by the pavement removal or planing process.
      
      When planed or milled surfaces will be opened to traffic, the Contractor shall maintain the existing pavement markings, or construct and/or remove temporary pavement markings in accordance with Section 900 or as directed by the Engineer. Prior to opening the planed or milled surface to traffic, the Contractor shall provide “Elevated Manholes” signs. Remove all loose material from the pavement surface before opening the planed or milled surface to traffic. Transition between milled and unmilled surfaces by feathering or constructing an asphaltic concrete pavement (ACP) wedge for vertical faces greater than one (1) inch. The maximum slope of such transitions shall be 1V:10H. The maximum edge drop between adjacent lanes open to traffic shall be one (1) inch. Install warning signs notifying motorists of uneven lanes.
Locate and protect any manholes, valve boxes, or other appurtenances, some of which may be below the surface of the street, from damage by the removal process. The Contractor shall be responsible for repairing or replacing any damaged manholes, valve boxes, or other appurtenances as a result of the removal or milling operations. The City is not responsible for any equipment damage resulting from manholes, valve boxes, or other appurtenances.

Prior to the start of planing on each segment of roadway, the Contractor shall provide a physical method of protecting inlets, manholes, flumes, or other appurtenances from contamination by millings or other loose particles generated during planing or cleaning of the planed surface. Such protection measures shall be removed at the end of each day's work. The Contractor shall remove any materials contaminating such appurtenances at the end of each day. Failure to remove such materials will result in withholding any progress payment for the work completed until such materials are removed.

Mechanical or vacuum brooms shall be able to pick up loose particles from the surface. The brooms shall be driven by an auxiliary motor or by a power take-off from the power plant of the unit propelling the sweeper. The sweeping unit shall be equipped with a suitable shield to prevent the loss of material and a continuously operating water spray unit of sufficient size to keep dust to a minimum, so as to comply with Omaha Municipal Code (OMC) 41-2. All temporary dumping or stockpiling areas utilized by the Contractor within the construction limits shall be cleaned up at the end of each workday. The Contractor shall cease operations to allow sufficient time to complete clean-up activities within the time restrictions in the Contract Documents. At no time shall loose particles greater than three-eighth (⅜) inch in diameter or unapproved piles of material remain on or adjacent to the roadway during hours of darkness. Failure to comply with these requirements will result in suspension of any other work without suspending or adding time until the above requirements are fulfilled.

When indicated in the Contract Documents, curb grinding shall be performed for construction of street widening or turn lane additions. Curb grinding machines shall be capable of grinding the existing PCC curb without damaging adjacent curb, pavement, or other structures.

B. Full Depth Removal

Saw cut the full depth of the pavement along the perimeter of all sections of pavement designated for removal. Full depth saw cutting along the perimeter of all removals associated with existing pavement, curb, sidewalk, curb ramps, median surfaces, concrete headers, driveways and pavement repairs shall be mandatory. After the saw cutting is complete, the Contractor shall remove the designated pavement. Perform removals in a manner that avoids undercutting or damaging any pavement designated to remain. Accomplish removal operations without damaging any cables, utility ducts, pipes, structures or other items not designated for removal or abandonment unless otherwise authorized in writing by the Engineer. Repair or replace any damaged pavement, cables, utility ducts, pipes, structures, or other appurtenances designated to remain at no expense to the City, and in accordance with the Contract Documents. Methods of repair not included within the Contract Documents shall be approved in writing by the Engineer prior to repair work. Unless otherwise indicated in the Contract Documents, the removed pavement shall become the property of the Contractor and shall be properly disposed of at a location off-site in accordance with Section 100.

C. Cold Planing

Mill the pavement to the required depth in accordance with the Contract Documents and Standard Plates. Use a commercially manufactured milling machine designed for the intended use. The milling machine shall be self-propelled, of sufficient weight, size, power, and traction
to remove surface irregularities without tearing or displacing the remaining pavement. The cutting edge shall allow for adjustment to meet the required crown. Do not perform cold planing by scarifying, blading, or heating.

The milling machine shall have automatic controls for establishing profile grades on each side of the machine using the existing pavement and/or a taut reference line. The milling machine shall be equipped to provide a vertical planed surface to within eight (8) inches from the back of curb. Reference the existing pavement using a self-contained system that references twenty-five (25) linear feet of existing pavement and compensates for humps or depressions three (3) feet or less in length. Do not use a joint matching shoe as a reference system.

The Contractor shall utilize a ski attachment, or other similar device, to control the profile of the milled surface in all areas greater than fifty (50) feet from roadway intersections. The use of a wheel, matching shoe, or other devices to solely control the depth or profile of the milled surface is not permitted without written approval of the Engineer. The ski attachment shall span a distance of not less than ten (10) feet.

The milling machine shall remove the millings from the surface using a loading elevator. The Contractor shall continuously collect pavement millings and remove this material from the site during milling operations. The Contractor shall not stockpile millings on site at any time. Deliver the pavement millings in accordance with the Contract Documents or as directed by the Engineer. Pavement millings not retained by the City shall become the property of the Contractor.

Accomplish cold planing by performing multiple passes of the milling machine as necessary to remove the surface to the depth indicated in the Contract Documents or as directed by the Engineer.

The Contractor shall cut or otherwise remove and dispose of any wire mesh or other protrusions from the milled surface before opening an area to traffic. No piles or shoulder litter shall be permitted. The Contractor shall also monitor the milled surface for protruding wires until the area is surfaced. No payment will be made directly for this work but shall be considered incidental to items for which the Contract provides direct payment.

All cold planing shall include grinding around all utility appurtenances. All butt joints shall be established by cross milling. Properly barricade any appurtenance and header that is greater than one (1) inch higher than the planed surface until temporary hot mix asphalt patches can be constructed to comply with the height specification. Remove all temporary asphalt patches before placement of any wedge or surface lifts.

The Contractor shall correct any areas milled deeper than directed at no additional cost to the City and in a manner acceptable to the Engineer.

The Contractor shall clean up and remove all construction debris on curbs, sidewalks, medians, islands, parking areas, etc., within forty-eight (48) hours following the milling operations using mechanical or vacuum brooms where practical.

D. Reclamation

Reclamation shall consist of full depth in-place pulverization and blending of the existing pavement and existing base to a minimum depth of (12) inches to a width indicated in the plans or as directed by the Engineer. The Contractor shall perform the in-place pulverization in a manner that mixes the existing pavement and existing base material to a uniform consistency.
Prior to in-place pulverization, the Contractor shall locate and flag all utilities to verify the location and depth of all utilities.

The Contractor shall perform the in-place pulverization operations in a manner to avoid leaving abrupt longitudinal difference between adjacent lanes.

The Contractor shall grade, shape, and compact the reclaimed material in accordance with Section 200 immediately following the in-place pulverization operations. The compaction shall be performed in accordance with Table 200.01 using equipment and hand work to produce a smooth surface.

The Contractor shall trim the reclaimed and blended material to a depth of four (4) inches or to the depth indicated in the Contract Documents or as directed by the Engineer. The Contractor shall remove excess material from trimming operations and haul off site in accordance with Section 200. The Contractor shall roll the trimmed surface with a smooth drum roller to eliminate localized bumps, depressions and/or ruts, and to create a smooth profile and cross section, and shall repair any damage to the trimmed surface prior to the construction of the Asphaltic Concrete Pavement. The trimmed surface shall meet compaction requirements in accordance with Table 200.01.

During reclamation operations, properly barricade any appurtenance and header that is greater than one inch higher than the planed surface until temporary hot mix asphalt patches can be constructed to comply with this height specification. Remove all temporary asphalt patches before placement of any surface lifts.

All reclamation will include the grinding around all utility appurtenances.

E. Diamond Grinding

Diamond grinding shall be accomplished in accordance with the Contract Documents or as directed by the Engineer. Grinding shall be done utilizing diamond blades mounted on self-propelled machines designed for grinding and texturing pavements. The cutting head shall be at least thirty-six (36) inches wide and consist of diamond blades with spacers. The equipment shall be such that it will not cause strain or damage to the underlying surface of the pavement. Equipment that causes excessive raveling, aggregate fractures, spalls, or disturbance of transverse or longitudinal joints shall not be permitted.

Grinding shall be done in the longitudinal directions so that grinding begins and ends at lines perpendicular to the pavement centerline within one ground area, but not necessarily at the end of each shift or of a working day. Grinding shall not leave a vertical projection in excess of one-fourth (¼) inch on any longitudinal line and at either edge of the pavement. The maximum depth of grinding that shall be permitted is one-half (½) inch.

Removal of all slurry or residue from the grinding operations shall be continuous. Pavement shall be left in a clean condition. Residue from grinding operations shall not be permitted to flow into gutters or other drainage facilities. The residue shall be collected and become the property of the Contractor and removed from the project.

The Contractor shall be responsible for inspecting the corrected surface. The Contractor shall notify the Engineer before conducting the inspection, and records of such inspections shall be submitted to the Engineer.
105.04 Acceptance

The Engineer shall observe the work to check for compliance with the Contract Documents.

Removal of pavement will be inspected by the Engineer for visual acceptance. The Engineer will check surrounding pavement and existing appurtenances to verify any such items are free of damage, or to determine if repairs are required.

Cold planning will be inspected by the Engineer for visual acceptance. The Engineer will check surrounding pavement and existing appurtenances to verify any such items are free of damage, or to determine if repairs are required.

Reclaimed subgrade shall meet the compaction requirements of Table 200.01.

Diamond grinding shall be used to correct all bumps greater than one-fourth (¼) inch in a ten (10) foot span. Newly constructed pavement requiring more than one-half (½) inch grinding to bring into conformance with the Contract Documents shall be removed and replaced at no cost to the City.

105.05 Measurement and Payment

Integral curb removed in conjunction with pavement removal shall not be measured separately but shall be subsidiary to pavement removal. Providing temporary barricading and pavement transitions at any appurtenance or header is subsidiary to items for which the Contract provides direct payment. All necessary surface preparation and clean up shall not be paid for directly but shall be incidental to items for which the Contract provides direct payment.

The Engineer shall measure cold planing of pavements for payment by the square yards of the thickness and type of pavement milled, delivered or removed, and accepted. Providing temporary barricading and pavement transitions at any appurtenance or header is subsidiary to items for which the Contract provides direct payment. When milling extends to an average depth greater than the limits contained herein, or as directed by the Engineer, measurement for payment of such areas shall be in accordance with Table 105.01.

<table>
<thead>
<tr>
<th>Additional Depth Requested</th>
<th>Measured Quantity Adjustment Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth Greater than Maximum Specified</td>
<td>To and Including</td>
</tr>
<tr>
<td>0.00”</td>
<td>1.50”</td>
</tr>
<tr>
<td>1.50”</td>
<td>3.00”</td>
</tr>
<tr>
<td>3.00”</td>
<td>4.50”</td>
</tr>
<tr>
<td>4.50”</td>
<td>6.00”</td>
</tr>
<tr>
<td>6.00”</td>
<td>9.00”</td>
</tr>
</tbody>
</table>

The Engineer shall measure full depth removal of pavements for payment by the square feet or square yards of the thickness and type of pavement, multi-use trail, driveway, sidewalk, mow strip, or median surfacing removed, disposed of, and accepted.
The Engineer shall measure removal of curbs for payment by the linear feet of the thickness of curb removed, disposed of, and accepted. Curb removal when the curb is integral to the pavement shall be subsidiary to items for which the Contract provides direct payment.

The Engineer shall measure removal of combination curbs and gutters for payment by the linear feet of combination curb and gutter removed, disposed of, and accepted.

The Engineer shall measure removal of concrete headers for payment by the linear feet of header removed, disposed of, and accepted.

The Engineer shall measure grinding of curbs for payment by the linear feet of curb ground, disposed of, and accepted.

The Engineer shall measure full–depth saw cuttings for payment by the linear feet of pavement saw cut and accepted. Full depth saw cutting for driveways and walkways shall be subsidiary to items for which the Contract provides direct payment.

The Engineer shall measure reclamation for payment by the square yards of pavement pulverized, blended, graded, compacted and accepted.

The Engineer shall measure trimming for payment by the cubic yards of reclaimed material removed, disposed of, and accepted.

The Engineer shall measure diamond grinding of pavements for payment by the square yards of pavement ground, disposed of, and accepted.

Payment shall be made under the following unless otherwise indicated in the Contract Documents. The Contract Price shall be full compensation for removal, cold planing, reclamation, grading, trimming, compacting, grinding, loading, hauling, disposal, and for furnishing all materials, labor, equipment, tools, traffic control devices, and all incidentals necessary to complete the work.

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perform ___ Cold Planing – Asphalt</td>
<td>Square Yard</td>
</tr>
<tr>
<td>Perform ___ Cold Planing – Concrete</td>
<td>Square Yard</td>
</tr>
<tr>
<td>Remove ___ Pavement</td>
<td>Square Yard</td>
</tr>
<tr>
<td>Remove ___ Driveway</td>
<td>Square Yard</td>
</tr>
<tr>
<td>Remove Multi-Use Trail</td>
<td>Square Yard</td>
</tr>
<tr>
<td>Remove Mow Strip</td>
<td>Square Foot</td>
</tr>
<tr>
<td>Remove Sidewalk</td>
<td>Square Foot</td>
</tr>
<tr>
<td>Remove Median Surfacing</td>
<td>Square Foot</td>
</tr>
<tr>
<td>Remove ___ Curb</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Remove Combination Curb and Gutter</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Remove Concrete Header</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Grind Existing Curb</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Saw Cut – Full Depth</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Reclamation</td>
<td>Square Yard</td>
</tr>
<tr>
<td>Perform Trimming</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>Perform Diamond Grinding</td>
<td>Square Yard</td>
</tr>
</tbody>
</table>
106 Brick or Stone Block Removal

106.01 General
A. Description
This work includes removing and disposing of, or salvaging, of brick or stone block pavement, driveways, walkways, steps, and cushion material as indicated in the Contract Documents.

B. Submittal Requirements
Refer to Section 100.01 B for submittal requirements.

106.02 Material Requirements
A. General
Refer to Section 100.02 for general material requirements.

106.03 Construction Requirements
A. General
Refer to Section 100.03 for general construction requirements, in addition to the following requirements. Remove all brick or stone block pieces and bedding materials in such a manner as to salvage the maximum number of pieces for cleaning and reuse. When indicated in the Contract Documents, the City shall retain ownership of the brick or stone block pieces. The Contractor shall be responsible for sorting and palletizing undamaged pieces and delivering to a location designated in the Contract Documents or as directed by the Engineer. All materials not designated for salvage, and any unsalvageable materials, shall become the property of the Contractor and shall be properly disposed of in accordance with Section 100.03.

106.04 Acceptance
The Engineer shall observe the work to check for compliance with the Contract Documents.

106.05 Measurement and Payment
The Engineer shall measure brick removals for payment by the square yards of the type of brick surface removed and disposed of; or salvaged, delivered, and accepted. Removing and disposing of existing sand bedding shall be subsidiary to brick removal.

The Engineer shall measure stone block removals for payment by the square yards of the type of stone block surface removed and disposed of; or salvaged, delivered, and accepted. Removing and disposing of existing sand bedding shall be subsidiary to stone block removal.

Payment shall be made under the following unless otherwise indicated in the Contract Documents. The Contract Price shall be full compensation for the cost of removal and disposal; or removing, salvaging, and delivering; excavating and backfilling; and for furnishing all materials, labor, equipment, tools, and all incidentals necessary to complete the work.

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remove Brick ___</td>
<td>Square Yard</td>
</tr>
<tr>
<td>Remove Stone Block ___</td>
<td>Square Yard</td>
</tr>
</tbody>
</table>
107  Traffic Signal Removal

107.01  General
   A. Description
      This work includes removing and disposing of, or salvaging, of traffic signal equipment, cabinets, poles, structures, foundations, and wiring as indicated in the Contract Documents.

   B. Submittal Requirements
      Refer to Section 100.01 B for submittal requirements.

107.02  Material Requirements
   A. General
      Refer to Section 100.02 for general material requirements.

107.03  Construction Requirements
   A. General
      Refer to Section 100.03 for general construction requirements, in addition to the following requirements.

      Remove and dispose of all signal poles, structures, foundations, traffic controllers, controller cabinets, signal heads, cable, wire, and miscellaneous related items at the locations indicated in the Contract Documents. Salvage and store or deliver to the designated location(s) any items identified in the Contract Documents as being reused or retained by the City.

      Remove any concrete foundations to a minimum depth of three (3) feet below the finished ground elevation.

      Backfill requirements shall be in accordance with Section 200.

107.04  Acceptance
   The Engineer shall observe the work to check for compliance with the Contract Documents. Backfill shall be constructed to the minimum compaction requirements identified in the Contract Documents. The Engineer shall verify the compaction of the backfill in accordance with the City of Omaha Materials and Testing Manual for Public Works Construction.

107.05  Measurement and Payment
   Backfilling of any cavities created by the removal of a structure or foundation is subsidiary to items for which the Contract provides direct payment.

   The Engineer shall measure removal and disposal of traffic signal systems for payment by a lump sum for the removal, backfill, disposal, and acceptance of all traffic signal equipment, poles, wiring, conduits, ducts, structures, and foundations.

   The Engineer shall measure removal and salvage of traffic signal systems for payment by a lump sum for the removal, backfill, salvage, delivery, and acceptance of all traffic signal equipment, poles, wiring, and other appurtenances as indicated in the Contract Documents.

   Payment shall be made under the following unless otherwise indicated in the Contract Documents. The Contract Price shall be full compensation for the cost of removal and disposal, or salvage and
delivery; excavation; backfilling; and for furnishing all materials, labor, equipment, tools, and all incidentals necessary to complete the work.

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remove and Dispose Traffic Signal System</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>Remove and Salvage Traffic Signal System</td>
<td>Lump Sum</td>
</tr>
</tbody>
</table>
SECTION 200 – EARTHWORK

200 Earthwork

200.01 General

A. Description

The information, submittal requirements, material requirements, and construction requirements shall apply to all subsections within Section 200 unless otherwise specified. This section includes earthwork, excavation and embankment, subgrade preparation, fly ash stabilization of soils and subgrade, supplying and placing flowable fill, and backfilling, compaction, drainage control, erosion control, and dust control necessary to meet the requirements of the Contract Documents or applicable state and federal laws.

B. Submittal Requirements

The Contractor shall submit, in accordance with the General Conditions, the following submittals:

1. Excess and Unsuitable Material Disposal

The Contractor shall identify in writing the location(s) of the excess and unsuitable material disposal site and provide this to the Engineer at the pre-construction meeting. The Contractor shall be responsible for maintaining a log recording the disposal dates, description of material, and approximate amount of material hauled.

2. Borrow Site Location

The Contractor shall provide the Engineer an aerial photo of the proposed borrow site location, a copy of all necessary permits, and a copy of a soils analysis report prepared by an independent geotechnical firm. The Contractor shall be responsible for determining the necessity and obtaining any permits for the proposed borrow site. Examples of such permits may include, but shall not be limited to, a Storm Water Pollution Prevention Plan (SWPPP), a National Pollutant Discharge Elimination System (NPDES) permit, a 404 Clean Water Act permit, a 401 Water Quality certification, or other permits required by government and regulatory agencies. The soils analysis report shall include a classification of the major types of soil present on the site, a proctor test of the soil(s), and a statement certifying the borrow material is generally free of debris, suitable for the intended use, and in compliance with the Contract Documents. The Engineer reserves the right to accept or reject such location based on the submitted information regarding the proposed borrow material only. In the event the borrow site location is rejected, the Contractor shall submit an alternate borrow site location for approval.

3. Fly Ash Stabilization

The Contractor shall provide certification that the fly ash material complies with the requirements for Class C Fly Ash in accordance with ASTM C593, Standard Specification for Fly Ash and Other Pozzolans for Use with Lime for Soil Stabilization.

4. Flowable Fill Mix Design

The Contractor shall submit a Flowable Fill Mix Design in accordance with Section 204.
200.02 Material Requirements

A. Borrow Material

Borrow material shall consist of silt (ML), silty clay (CL-ML) or lean clay (CL) materials as determined in accordance with ASTM D2487, Standard Practice for Classification of Soils for Engineering Purposes. Borrow material shall meet the moisture content requirements of Table 200.01. Borrow material shall be free of debris, vegetation, frozen material, and organic matter. The Contractor shall not be allowed to begin work at borrow sites until the Engineer has accepted the submittal information.

B. Unsuitable Materials

Unsuitable materials shall include all materials that contain debris, roots, organic or frozen materials, stone having a maximum dimension larger than three (3) inches for the upper twelve (12) inches of fill, stones having a maximum dimension larger than six (6) inches for the remainder of the fill, or any other materials determined by the Engineer to be unsuitable for providing a stable slope, embankment, backfill, or subgrade. Material with a moisture content not meeting the requirements of Table 200.01 shall not be classified as unsuitable material unless it cannot be manipulated, aerated, or blended with other materials as determined by the Engineer. Such material alteration shall be performed in accordance with Section 200.03 C and 201.

C. Topsoil

Refer to Section 800 for topsoil material requirements.

200.03 Construction Requirements

A. Equipment

Use equipment in working condition and designed for use in the manner proposed. Use compaction equipment and techniques that consistently produce the required compaction throughout the depth of the compacted lift. Do not use equipment that produces a smooth, glossy surface or detrimental laminations within the compacted lifts. A drop hammer shall not be used for compaction.

Use techniques that avoid damaging utilities located within the limits of the proposed construction. Notify the Engineer of any utilities that interfere with the proposed work. Repair any damage to the utilities or related services to the satisfaction of the utility owner at no additional cost to the City.

Equipment used for hauling materials to or from the site shall be licensed, insured, and operated in such a manner as to comply with all local, state, and federal requirements, including but not limited to covering the material(s) being hauled.

B. Compaction

Compact the material uniformly so that it does not yield under repeated loading by heavy trucks or equipment. Construct the earthwork to meet the requirements of Table 200.01. The maximum dry density and optimum moisture shall be determined in accordance with ASTM D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft$^3$ (600 kN-m/m$^3$)); or ASTM D1557, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft$^3$ (2,700 kN-m/m$^3$)).
# Table 200.01

## Earthwork Compaction Requirements

<table>
<thead>
<tr>
<th>Description</th>
<th>Locations (Typical)</th>
<th>Depth Below Pavement or Finished Grade</th>
<th>Minimum Compaction Requirement</th>
<th>Acceptable Moisture Range</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Subgrade Preparation</strong></td>
<td>Under and within 3’ of edge of <strong>rigid</strong> pavement; under driveways, multi-use trails, sidewalks*</td>
<td>Bottom of pavement to 1’ below pavement</td>
<td>90% of Maximum Dry Density (MOD) (ASTM D1557)</td>
<td>3% Below to 4% Above Optimum Moisture Content (Typical)</td>
</tr>
<tr>
<td><strong>Subgrade Preparation</strong></td>
<td>Under and within 3’ of edge of <strong>flexible</strong> pavement; under multi-use trails</td>
<td>Bottom of pavement to 1’ below pavement</td>
<td>92% of Maximum Dry Density (MOD) (ASTM D1557)</td>
<td>3% Below to 4% Above Optimum Moisture Content (Typical)</td>
</tr>
<tr>
<td><strong>Shoulder Preparation</strong></td>
<td>Back of curbs; adjacent to finished driveways, multi-use trails, sidewalks</td>
<td>Top of finished grade to top of prepared subgrade</td>
<td>92% of Maximum Dry Density (STD) (ASTM D698)</td>
<td>3% Below to 4% Above Optimum Moisture Content (Typical)</td>
</tr>
<tr>
<td><strong>Backfill</strong></td>
<td>Trenches, structures, voids from removal of objects</td>
<td>1’ to 5’ below pavement (all locations, all excavation widths)</td>
<td>95% of Maximum Dry Density (STD) (ASTM D698)</td>
<td>3% Below to 4% Above Optimum Moisture Content (Typical)</td>
</tr>
<tr>
<td><strong>Backfill</strong></td>
<td>Trenches, structures, voids from removal of objects</td>
<td>Greater than 5’ below pavement (all locations)**</td>
<td>92% of Maximum Dry Density (STD) (ASTM D698)</td>
<td>3% Below to 6% Above Optimum Moisture Content (Typical)</td>
</tr>
<tr>
<td><strong>Embankment</strong></td>
<td>Fill areas, slopes, areas beyond pavement</td>
<td>Greater than 1’ (all locations)</td>
<td>95% of Maximum Dry Density (STD) (ASTM D698)</td>
<td>3% Below to 4% Above Optimum Moisture Content (Typical)</td>
</tr>
<tr>
<td><strong>Embankment, Fine Grading</strong></td>
<td>Fill areas, slopes, areas beyond pavement</td>
<td>Less than 1’ (all locations)</td>
<td>92% of Maximum Dry Density (STD) (ASTM D698)</td>
<td>3% Below to 4% Above Optimum Moisture Content (Typical)</td>
</tr>
</tbody>
</table>

*All sidewalk thicknesses require 6” subgrade preparation.

**Excavations and trenches wider than 6’ require 95% of Maximum Dry Density (STD) (ASTM D698) (-3% to +4% Moisture Content).
Any removal, manipulation, aeration, replacement, and re-compaction of suitable materials necessary to obtain the required compaction shall be considered incidental to items for which the Contract provides direct payment.

C. Unsuitable Material Excavation

The Contractor shall inform the Engineer of material suspected to be unsuitable. The Engineer shall evaluate the materials and determine if the materials are unsuitable for construction. Remove all unsuitable materials to the depth required by the Contract Documents or as directed by the Engineer. After removal of the unsuitable materials, backfill the unsuitable material excavation in accordance with Section 205. Properly dispose of unsuitable excavated materials in accordance with submittal requirements, on-site, as indicated in the Contract Documents, or as directed by the Engineer. Do not place unsuitable material in wetlands or other legally protected areas.

D. Site Protection from Weather

The Contractor shall provide adequate drainage control to protect the work site, and shall construct drainage facilities and erosion control measures necessary to divert or store runoff, and protect the natural ground, fills, cuts, trenches, or subgrade under constructed pavements of the project. This work shall be constructed in accordance with Section 100. Unless otherwise indicated in the Contract Documents, this work shall be considered incidental to items for which the Contract provides direct payment.

E. Dust Control

The Contractor shall be responsible for controlling dust generated from the project site. Dust control methods may include, but not be limited to, applying water or dust palliative and covering active and inactive stockpiles. Dust control shall be performed when soil disturbing activities are being performed, or when directed by the Engineer. Soil disturbing activities include, but are not limited to, earthwork, excavation and trenching, paving, and when vehicles are entering and leaving the job site. Dust control shall be incidental to other items for which the Contract provides direct payment.

F. Hazardous Materials

In the event hazardous materials or hazardous waste is encountered, the Contractor shall proceed in accordance with the General Conditions, and all applicable state and federal laws.
201 Excavation and Embankment

201.01 General
   A. Description
      This work includes all excavation and embankment necessary for construction to prepare and
      complete the alignments, grades, and cross sections as indicated in the Contract Documents.
      Unless otherwise indicated in the Contract Documents, this work includes removal, disposal,
      and backfill of all materials encountered, including rock, earth, and unsuitable materials to the
      extent necessary for completing all work.

   B. Submittal Requirements
      Refer to Section 200.01 B for submittal requirements.

201.02 Material Requirements
   A. General
      Refer to Section 200.01 B for submittal requirements.

201.03 Construction Requirements
   A. General
      Refer to Section 200.03 for general construction requirements, in addition to the following
      requirements. Clearing and grubbing requirements shall be in accordance with Section 100, and
      shall be completed prior to commencing any excavation or embankment activities.

   B. Excavation
      Excavate to the lines, grades, and cross sections indicated in the Contract Documents. Grade
      excavation surfaces to be smooth and uniform. The finished elevation of the excavation shall
      be within one-tenth (0.1) foot of the design elevation.

      Dispose of excess excavated material as indicated in the Contract Documents or as directed by
      the Engineer. Do not place excess material in wetlands or other legally protected areas. The
      Engineer must approve the wasting of any excess excavated material. At the discretion of the
      Engineer, the Contractor may use suitable excess material to widen embankments and flatten
      slopes within the project. Obtain written arrangements with property owners and
      governmental authorities for disposal locations outside the project limits, in accordance with
      the submittal requirements in Section 200.01 B. Grade abandoned roadways to match the
      existing or original ground contour, or in accordance with the Contract Documents.

      Prepare and compact the upper twelve (12) inches of excavated areas in accordance with Table
      200.01. Perform all work required, including the application of water if necessary, to accomplish
      compaction of suitable materials at no additional cost to the City.

   C. Unsuitable Material Excavation
      Refer to Section 200.03 C for unsuitable material excavation requirements.

   D. Embankment
      The Contractor shall use on-site suitable excavation materials before using borrow material.
      Provide off-site borrow material when indicated in the Contract Documents. Do not obtain
      borrow material from any location within the project limits that is not identified as a borrow
      area in the Contract Documents.
Before beginning embankment construction, remove organic material and topsoil that may be present in the proposed embankment limits. Scarify the underlying surface to a minimum depth of six (6) inches, and then compact the scarified materials to the minimum density specified in Table 200.01. Scarify existing roadways to a minimum depth of six (6) inches and uniformly distribute the scarified materials across the full width of the embankment before commencing embankment construction.

Place embankment materials in uniform horizontal layers not exceeding eight (8) inches loose lift thickness. Level and compact each layer of the embankment material to the minimum density specified in Table 200.01, before placing additional layers. The Contractor shall adjust the moisture content as necessary to fulfill moisture requirements of Table 200.01. The Engineer reserves the right to alter the thickness of the lifts to meet the specific conditions of the project site. Place successive lifts in a manner that does not significantly alter the moisture content or density of previously completed lifts. No embankment material shall be placed, spread, or rolled while it is frozen or thawing, or during unfavorable weather conditions. No embankment material shall be placed, spread, or rolled on top of existing soils that are frozen or thawing. When the work is interrupted by heavy rain, embankment operations shall not be resumed until field tests by the Engineer indicate that the moisture content and density of the embankment are satisfactory.

Step the sides of existing natural or embankment slopes steeper than 1V:3H. The vertical depth of the step shall be less than one (1) foot and the vertical face shall be no steeper than 1V:1H. The base of the step shall be nearly horizontal. Extend the face horizontally into the existing natural or embankment slope until encountering stable soils. Horizontal cuts shall begin at the intersection of the ground line and the vertical side of the previous bench. Compact the materials excavated as part of stepping operations with the new embankment material.

Construct embankment to the lines, grades, and cross sections as indicated in the Contract Documents. Grade completed embankment surfaces to be smooth and uniform. The final elevation of the embankment shall be within one-tenth (0.1) foot of the design elevation.

**201.04 Acceptance**

The Engineer shall observe the work to check for compliance with the Contract Documents. Excavation and embankment shall be constructed to the minimum compaction requirements identified in the Contract Documents. The Engineer shall verify the compaction of the excavation and embankment in accordance with the City of Omaha Materials and Testing Manual for Public Works Construction. Any failing tests shall be excavated, re-compacted, and retested at no additional cost to the City. The limits of the failed area shall be determined by additional testing at intervals determined by the Engineer.

**201.05 Measurement and Payment**

All costs associated with obtaining and excavating a sufficient amount of off-site borrow materials are subsidiary to items for which the Contract provides direct payment. Any costs associated with obtaining permits or approvals are subsidiary to items for which the Contract provides direct payment. The cost of stockpiling or excavation of stockpiled materials, both on-site or off-site, before use or during the performance of the work, is subsidiary to items for which the Contract provides direct payment. Scarifying existing roadways is subsidiary to items for which the Contract provides direct payment. The cost of delays due to utilities located within the limits of the proposed construction is incidental to excavation or embankment construction. Coordination with utilities
shall be the Contractor’s responsibility and is considered subsidiary to items for which the Contract provides direct payment.

Any removal, manipulation, aeration, replacement, and re-compaction of suitable materials necessary to obtain the required compaction shall be considered incidental to items for which the Contract provides direct payment.

The Engineer shall measure excavations on-site for payment by the cubic yards of on-site material excavated and accepted. The Engineer reserves the right to verify the excavation quantity by before and after cross-section surveys. The Engineer shall exclude suitable materials temporarily removed and replaced to aid in compaction or re-compaction efforts. Embankment construction using on-site excavated materials will not be paid for separately, but shall be considered incidental to items for which the Contract provides direct payment.

Unless otherwise indicated in the Contract Documents, excavations haul-off shall be considered incidental to items for which the Contract provides direct payment. When indicated in the Contract Documents, the Engineer shall measure excavations haul-off for payment by the cubic yards of material excavated, hauled off-site, and accepted. The Engineer reserves the right to verify the excavation quantity by before and after cross-section surveys.

The Engineer shall measure unsuitable materials for payment by the cubic yards of material excavated, replaced, compacted, and accepted. The Engineer shall measure the volume of unsuitable material excavated in its original position by the method of average end areas. The Engineer reserves the right to verify the excavation quantity by before and after cross-section surveys.

The Engineer shall measure embankment-borrows for payment by the cubic yards of material hauled in, constructed, and accepted. The Engineer shall measure the volume of embankment constructed in its final position (actual amount of embankment constructed, not borrow material excavated). The Engineer will not include any surplus material placed outside the limits identified in the Contract Documents in the measurement for payment. The Engineer reserves the right to verify the excavation quantity by before and after cross-section surveys.

Payment shall be made under the following unless otherwise indicated in the Contract Documents.

The Contract Price shall be full compensation for excavation, embankment construction, material hauling, stockpiling, preparing slopes, stepping, disposal of surplus material and unsuitable material, grading, shaping, manipulation of excavation or embankment materials, compacting, watering, re-compacting, finishing, and for furnishing all labor, materials, equipment, tools, and all incidentals necessary to complete the work.

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excavation On-Site</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>Excavation Haul-Off</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>Unsuitable Material</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>Embankment-Borrow</td>
<td>Cubic Yard</td>
</tr>
</tbody>
</table>
202 Subgrade Preparation

202.01 General

A. Description

This work includes grading, shaping, scarifying, drying, watering, reshaping, and compacting embankments and excavated areas intended to be subgrade. This work shall be performed in accordance with Table 200.01 using equipment and hand work to produce a smooth surface conforming to the lines, grades and cross sections indicated in the Contract Documents or established by the Engineer, and disposing of surplus material. This work also includes trimming the subgrade to match lines, grades and cross sections and adjusting grade lines to meet intersections, pavements, bridge ends, railroad crossings, or any other physical features identified in the Contract Documents or as directed by the Engineer. Additionally, this work includes reconstructing the subgrade after removing existing pavements in preparation for pavement reconstruction.

B. Submittal Requirements

Refer to Section 200.01 B for submittal requirements.

202.02 Material Requirements

A. General

Refer to Section 200.02 for general material requirements.

202.03 Construction Requirements

A. General

Refer to Section 200.03 for general construction requirements, in addition to the following requirements. Scarify the subgrade to a minimum depth of twelve (12) inches below final subgrade elevation, then compact as required in Table 200.01. Shape or high trim the subgrade over the full width of the roadway to an elevation between zero to one-tenth (0.0 to 0.1) foot above the finished subgrade elevation. Compaction tests shall not be performed until the above construction activities have been performed.

Excavate and dispose of any unsuitable subgrade materials identified by the Engineer. Replace such materials using suitable soils, crushed aggregate or other method of stabilization, to the lines and grades indicated in the Contract Documents or as directed by the Engineer. The Contractor shall provide adequate drainage control to protect the subgrade at no additional cost to the City, including exposed subgrade and subgrade underneath constructed pavements. Repair unsuitable subgrade locations caused by the Contractor’s operations at no additional cost to the City.

Grade or final trim the subgrade surface to be smooth before constructing the base or surface course. The maximum allowable variation above the finished subgrade elevation shall be one-fourth (¼) inch. Smooth roll the finished subgrade surface to seal the top layer of the subgrade.

Trimmed material not needed for the construction of additional embankment width may be temporarily stored for use in shoulder construction, pavement backfill, or flattening embankment slopes. Stockpile or windrow such material in a manner and at such locations that allow for adequate drainage away from the subgrade, sub-base, or base course. Do not store such material in the traveled path when traffic is to be maintained through the construction area. Dispose of all excess trimmed material offsite unless otherwise directed by the Engineer.
Maintain the prepared subgrade until construction of surface course(s) is complete. Correct all damaged sections to fulfill the requirements of Table 200.01 before constructing the surface course(s).

**B. Unsuitable Subgrade Material**

Unsuitable subgrade material meeting the description of Section 200.02 B encountered within the roadway from finished subgrade elevation to a depth two (2) feet below such elevation shall be removed and replaced as directed by the Engineer. Any unsuitable material encountered outside these limits shall be considered unsuitable earthwork as described in Section 201. Excavate unsuitable subgrade materials to the depth required by the Contract Documents or as directed by the Engineer. After removal of the unsuitable subgrade materials, backfill the unsuitable subgrade material excavation in accordance with the requirements of Table 200.01. Dispose of excavated unsuitable subgrade material in accordance with Section 200. Do not place unsuitable subgrade materials in wetlands or other legally protected areas.

**202.04 Acceptance**

The Engineer shall observe the work to check for compliance with the Contract Documents. Subgrade preparation shall be constructed to the minimum compaction requirements identified in the Contract Documents. The Engineer shall verify the compaction of the subgrade in accordance with the City of Omaha Materials and Testing Manual for Public Works Construction. Any failing tests shall be excavated, re-compacted, and retested at no additional cost to the City. The limits of the failed area shall be determined by additional testing at intervals determined by the Engineer.

**202.05 Measurement and Payment**

Unless otherwise indicated in the Contract Documents, subgrade preparation is subsidiary to items for which the Contract provides direct payment.

Any removal, manipulation, aeration, replacement, and re-compaction of suitable materials necessary to obtain the required compaction shall be considered incidental to items for which the Contract provides direct payment.

When indicated in the Contract Documents, the Engineer shall measure subgrade preparations for payment by the stations of subgrade prepared and accepted. A station shall be defined as a one hundred (100) foot increment in the longitudinal direction along each street centerline as indicated in the Contract Documents and full width of the street in the transverse direction. Any additional subgrade preparation beyond plan and standard plate limits shall be incidental to items for which the Contract provides direct payment.

When indicated in the Contract Documents, the Engineer shall measure subgrade preparations for payment by the square yard of subgrade prepared and accepted. The quantity for payment shall be the overlying square yards of rigid or flexible pavement. Any additional subgrade preparation beyond plan and standard plate limits shall be incidental to items for which the Contract provides direct payment.

The Engineer shall measure unsuitable subgrade materials for payment by the cubic yards of material removed, replaced, compacted, and accepted. The Engineer shall measure the volume of material removed and replaced by identifying initial cross-sections before removal and final cross-sections after removal. The difference between the initial and final cross sections shall be the measured quantity.
Payment shall be made under the following unless otherwise indicated in the Contract Documents. The Contract Price shall be full compensation for removing, replacing, material hauling, stockpiling, preparing slopes, disposal of surplus and unsuitable material, grading, shaping, scarifying, manipulation of materials, compacting, watering, re-compacting, finishing; and for furnishing all labor, materials, equipment, tools, and all incidentals necessary to complete the work.

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subgrade Preparation</td>
<td>Station</td>
</tr>
<tr>
<td>Subgrade Preparation</td>
<td>Square Yard</td>
</tr>
<tr>
<td>Unsuitable Subgrade Material</td>
<td>Cubic Yard</td>
</tr>
</tbody>
</table>
203 Fly Ash Stabilization

203.01 General
A. Description
This work includes supplying and incorporating fly ash into the subgrade. The work of fly ash stabilization shall include minor grading, spreading, scarifying, drying, watering, reshaping, and compacting stabilized areas in accordance with Table 200.01 using equipment and hand work to produce a smooth surface conforming with the lines, grades and cross sections indicated in the Contract Documents or as directed by the Engineer, and disposing of surplus material.

B. Submittal Requirements
Refer to Section 200.01 B for submittal requirements.

203.02 Material Requirements
A. General
Refer to Section 200.02 for general material requirements, in addition to the following requirements.

B. Fly Ash
Fly ash shall comply with the requirements for Class C Fly Ash in accordance with ASTM C593, Standard Specification for Fly Ash and Other Pozzolans for Use With Lime for Soil Stabilization.

203.03 Construction Requirements
A. General
Refer to Section 200.03 for general construction requirements, in addition to the following requirements. The Engineer shall determine if fly ash stabilization is required for a given condition. Do not attempt fly ash incorporation if the air temperature is less than thirty-five (35) degrees Fahrenheit. Do not incorporate fly ash into frozen soils. Keep a water truck with water available at the project before fly ash stabilization begins. The Engineer reserves the right to suspend fly ash stabilization operations if jobsite or weather conditions become unfavorable.

The application rate for the fly ash shall be fifteen (15) to twenty (20) pounds per cubic foot of soil, depending on soil moisture conditions. The Engineer reserves the right to increase or decrease the application rate to meet specific soil conditions.

Uniformly incorporate the fly ash into the soil or subgrade to a depth of twelve (12) inches using a rotary pulverizer. The Engineer reserves the right to require the Contractor to construct a test strip of nine hundred (900) square yards or less to verify that the proposed method of incorporation is satisfactory.

B. Compaction
Begin compaction efforts immediately after incorporation of fly ash is complete and within one (1) hour of the start of stabilization operations. Compact the material uniformly to meet the requirements of Table 203.01 and to produce a compacted soil that does not yield under repeated loading by heavy trucks or equipment. Determine the maximum dry density and optimum moisture in accordance with ASTM D558, Standard Test Method for Moisture-Density Relations of Soil-Cement Mixtures. Adjust the moisture content of the fly ash and/or soil combination to meet the range required by adding and incorporating additional fly ash or water.
Do not lower the moisture content by aeration. Complete compaction efforts within two (2) hours of the start of stabilization operations.

<table>
<thead>
<tr>
<th>Table 203.01</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fly Ash Stabilization Requirements</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Minimum Compaction</th>
<th>Acceptable Moisture Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>95% of Maximum Dry Density</td>
<td>5% Below to 3% Above Optimum Moisture Content (Typical)</td>
</tr>
</tbody>
</table>

Grade the surface to be smooth. The maximum allowable variation from the finished subgrade elevation shall be in accordance with Section 202.03 A. Maintain the fly ash treated material until construction of subsequent layers is complete. Correct all finished sections damaged during construction operations to fulfill the requirements of Table 203.01 before constructing subsequent layers.

203.04 Acceptance

The Engineer shall observe the work to check for compliance with the Contract Documents. Fly ash stabilization shall be constructed to the minimum compaction requirements identified in the Contract Documents. The Engineer shall verify the compaction of the stabilization in accordance with the City of Omaha Materials and Testing Manual for Public Works Construction. Any failing tests shall be excavated, re-compacted, and retested at no additional cost to the City. The limits of the failed area shall be determined by additional testing at intervals determined by the Engineer.

203.05 Measurement and Payment

Any removal, manipulation, aeration, replacement, and re-compaction of suitable materials necessary to obtain the required compaction shall be considered incidental to items for which the Contract provides direct payment.

The Engineer shall measure fly ash stabilizations for payment by the tons of fly ash delivered, spread, incorporated, compacted, and accepted.

Payment shall be made under the following unless otherwise indicated in the Contract Documents. The Contract Price shall be full compensation for furnishing, incorporating, providing water, compacting, and for furnishing all labor, materials, equipment, tools, and all incidentals necessary to complete the work.

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construct Fly Ash Stabilization</td>
<td>Ton</td>
</tr>
</tbody>
</table>
204 Flowable Fill

204.01 General
A. Description
This work includes supplying and placing flowable fill to the lines, grades and cross sections indicated in the Contract Documents or as directed by the Engineer.

B. Submittal Requirements
Refer to Section 200.01B for submittal requirements.

204.02 Material Requirements
A. General
Refer to Section 200.02 for general material requirements, in addition to the following requirements.

B. Portland Cement for Flowable Fill
Portland cement shall comply with the requirements for Cement Type I or Cement Type II in accordance with ASTM C150, Specification for Portland Cement including Table 1, Table 2, and Table 4.

C. Aggregate for Flowable Fill
Aggregate requirements shall be in accordance with Section 500.

D. Water for Flowable Fill
Water requirements shall be in accordance with Section 500.

E. Flowable Fill Mix Proportioning and Required Properties
Prepare and submit a flowable fill mix design that identifies the component materials, the proportion of such materials, the twenty-eight (28) day compressive strength, and the air content. Proportion the materials to produce a mixture with a consistency that flows under a very low head. Determine compressive strength in accordance with ASTM D4832, Standard Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders. Determine air content in accordance with ASTM D6023, Standard Test Method for Unit Weight, Yield, Cement Content, and Air Content (Gravimetric) of Controlled Low Strength Material (CLSM).

For sewer pipe and existing structure abandonment applications, flowable fill shall have a twenty-eight (28) day compressive strength of fifty to seventy-five (50 to 75) pounds per square inch (psi) and an air content of ten plus or minus three (10±3) percent. For pipe bedding or trench backfill applications, flowable fill shall have a twenty-eight (28) day compressive strength of one hundred to one hundred twenty-five (100 to 125) psi and an air content of ten plus or minus three (10±3) percent.

204.03 Construction Requirements
A. General
Refer to Section 200.03 for general construction requirements for backfill operations. Refer to Section 500 for equipment and placement requirements.
B. Abandonment
Pipe and structure abandonment shall be in accordance with Section 100.

C. Pipe Bedding and Trench Backfill
Pipe bedding and trench backfill shall be in accordance with Section 700.

204.04 Acceptance
The Engineer shall observe the work to check for compliance with the Contract Documents. Flowable fill shall be constructed to the minimum compressive strength requirements identified in the Contract Documents. The Engineer shall verify the compressive strength of the flowable fill in accordance with the City of Omaha Materials and Testing Manual for Public Works Construction. Flowable fill material that does not meet the minimum strength requirement shall be removed and replaced at no additional cost.

204.05 Measurement and Payment
The Engineer shall measure flowable fills for payment by the cubic yards of the type of flowable fill supplied, constructed, and accepted.

Payment shall be made under the following unless otherwise indicated in the Contract Documents. The Contract Price shall be full compensation for furnishing all labor, materials, equipment, tools, and all incidentals necessary to complete the work.

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construct Flowable Fill – ___ (psi)</td>
<td>Cubic Yard</td>
</tr>
</tbody>
</table>
205 Backfill

205.01 General
A. Description
This work includes placing and compacting fill material to the lines, grades and cross sections indicated in the Contract Documents or as directed by the Engineer. Backfill may be required as a result of, but shall not be limited to, removal and/or construction operations, trench excavation, structure construction, and other work.

B. Submittal Requirements
Refer to Section 200.01 B for submittal requirements.

205.02 Material Requirements
A. General
Refer to Section 200.02 for general material requirements, in addition to the following requirements.

B. Backfill Material
Backfill material shall consist of on-site excavated material, and shall not contain debris, vegetation, organic matter, frozen material, or stones greater than two (2) inches in diameter. The moisture content of backfill material shall meet the requirements of Table 200.01. Backfill material not meeting the moisture content requirements shall be manipulated, aerated, or blended with other materials. Such material alteration shall be performed at no additional cost to the City.

C. Borrow Material
Refer to Section 200.02 for borrow material requirements.

D. Flowable Fill
Refer to Section 204.02 for flowable fill material requirements.

205.03 Construction Requirements
A. General
Refer to Section 200.03 for general construction requirements, in addition to the following requirements. Backfilling operations shall consist of filling voids and cavities resulting from removals or clearing and grubbing operations; placing fill material in trenches, around manholes or structures; and placing fill material beyond edges of pavement, sidewalks, multi-use trails, or other permanent improvements.

Proposed backfill material suspected of not meeting the moisture requirements of Table 200.01 shall be tested by the Contractor. The test results shall be submitted in writing to the Engineer to determine whether the material shall be manipulated to meet the moisture requirements.

Backfill material shall be placed and compacted in accordance with Table 200.01 and Section 200.03. Backfill material shall be placed in loose lifts not to exceed six (6) inches. When placing backfill material atop clay pipe, the first lift shall be twelve (12) inches in depth to avoid damaging the pipe. Backfill material shall be replaced to the existing lines and grades unless otherwise indicated in the Contract Documents or as directed by the Engineer. Grade and shape the finished surfaces to provide adequate drainage.
Backfilling of structures shall not commence until the required strengths have been attained, unless otherwise directed by the Engineer. When backfilling adjacent to or above a structure, compact the fill material without applying excessive pressure against the structure. Limit the placement of fill material adjacent to a bridge to a level equal to the base of the back wall elevation until the superstructure is in place. Place backfill material on all sides of the structure simultaneously.

Dispose of surplus excavated material in accordance with Section 200.03.

205.04 Acceptance

The Engineer shall observe the work to check for compliance with the Contract Documents. Backfill shall be constructed to the minimum compaction requirements identified in the Contract Documents. The Engineer shall verify the compaction of the backfill in accordance with the City of Omaha Materials and Testing Manual for Public Works Construction. Any failing tests shall be excavated, re-compacted, and retested at no additional cost to the City. The limits of the failed area shall be determined by additional testing at intervals determined by the Engineer.

For trenches with sewers or utilities, the recommended rate of compaction testing is two (2) tests in a length of three-hundred fifty (350) feet, approximately every two (2) feet in depth.

205.05 Measurement and Payment

Any removal, manipulation, aeration, replacement, and re-compaction of suitable materials necessary to obtain the required compaction shall be considered incidental to items for which the Contract provides direct payment.

Backfill operations shall be incidental to items for which the Contract provides direct payment. The Contract Price shall be full compensation for furnishing all labor, materials, equipment, tools, and all incidentals necessary to complete the work.
SECTION 300 – AGGREGATE SURFACE AND BASE COURSES

300 Aggregate Surface and Base Courses

300.01 General

A. Description
The information, submittal and material requirements, and construction requirements shall apply to all subsections within Section 300 unless otherwise specified. This section includes aggregate base, subbase, and surface courses.

B. Submittal Requirements
The Contractor shall submit, in accordance with the General Conditions, the following submittals:
1. Aggregate material gradation and physical property certifications.
2. Biaxial Geotextile Grid material certifications and installation requirements.
3. Geotextile Fabric material certifications and installation requirements.

300.02 Material Requirements

A. Aggregate
Aggregate for subbase, base, or surface course shall be in accordance with ASTM D2940, Standard Specification for Graded Aggregate Material for Bases or Subbases for Highways or Airports excluding any gradation requirements, and Table 300.01.

<table>
<thead>
<tr>
<th>Physical Property</th>
<th>Acceptable Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium Sulfate Soundness, ASTM C88 (5 cycles)*</td>
<td>10.0% maximum loss</td>
</tr>
<tr>
<td>Magnesium Sulfate Soundness, ASTM C88 (5 cycles)*</td>
<td>15.0% maximum loss</td>
</tr>
<tr>
<td>Freeze-Thaw Soundness, AASHTO T103 (15 cycles)*</td>
<td>15.0% maximum loss</td>
</tr>
<tr>
<td>LA Abrasion, ASTM C131 and ASTM C535</td>
<td>40.0% maximum loss</td>
</tr>
<tr>
<td>Absorption, ASTM C127 and ASTM C128</td>
<td>3.0% maximum</td>
</tr>
</tbody>
</table>

*Only one of the three soundness requirements must be fulfilled.

B. Biaxial Geotextile Grid
The biaxial geotextile grid shall be a type specifically manufactured for reinforcement applications. It shall consist of a network of integrally connected polymer tensile elements. The aperture size shall allow for mechanical interlock of the surrounding materials. The geotextile grid shall have tensile and junction strength elements and shall be constructed of either a polyethylene, polypropylene or high tenacity polyester that resists deformation due to dynamic forces. Table 300.02 illustrates the minimum average roll values (MARV) required for biaxial geotextile grid.
Table 300.02
Biaxial Geotextile Grid Requirements

<table>
<thead>
<tr>
<th>Physical Property</th>
<th>Cross Machined Direction</th>
<th>Machined Direction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tensile Strength at 2% Strain</td>
<td>450 lb/ft</td>
<td>280 lb/ft</td>
</tr>
<tr>
<td>Tensile Modulus</td>
<td>24,700 lb/ft</td>
<td>15,200 lb/ft</td>
</tr>
<tr>
<td>Ultimate Grid Junction Strength</td>
<td></td>
<td>490 lb/ft</td>
</tr>
<tr>
<td>Flexural Stiffness</td>
<td></td>
<td>250,000 mg-cm</td>
</tr>
</tbody>
</table>

Referenced Test Procedures:


C. Geotextile Fabric

Geotextile fabric shall be in accordance with AASHTO M288, Geotextile Specification for Highway Applications for the type and use indicated in the Contract Documents.

300.03 Construction Requirements

A. Equipment

Use equipment in working condition and designed for use in the manner proposed. Use hauling equipment equipped for dumping material into spreader boxes, piles, or windrows. Use equipment designed and maintained to prevent loss or segregation of materials during hauling or handling operations. Use compaction equipment and techniques that consistently produce the required compaction throughout the depth of the compacted lift.

B. Aggregate Placement, Compaction, and Finishing

Haul, uniformly place, and compact the aggregate without causing segregation, displacement, or damage to the underlying subgrade or subbase. The maximum thickness of a compacted lift of aggregate material shall be six (6) inches. Use methods and equipment that do not produce laminated surfaces between lifts of aggregate material.

Do not place aggregate material if the ambient air temperature is below thirty-five (35) degrees Fahrenheit. Shape the aggregate material to produce a uniform surface meeting the requirements for line and grade as required by the Contract Documents.

Compact the aggregate material to ninety-eight (98) percent of the maximum density in accordance with ASTM D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort. Maintain the moisture content of the aggregate material in a range that facilitates achieving the required compaction.

Construct the aggregate material to a thickness within one-half (½) inch of the thickness indicated in the Contract Documents. The Engineer shall conduct thickness measurements after the Contractor has completed final grading. The Contractor shall correct all non-conforming areas as directed by the Engineer and scarify aggregate layers to the depth of the underlying material or a minimum depth of four (4) inches before reworking.
Each completed course shall be free of ruts or other surface damage. The Contractor is responsible for protecting and maintaining the finished courses. Repair any damaged or deficient areas at no additional cost to the City.

Protect the compacted aggregate materials until completion of the construction of subsequent layers. Repair any damaged or deficient area at no additional cost to the City.

C. Biaxial Geotextile Grid Installation

Install biaxial geotextile grid in accordance with the manufacturer's recommendations. The manufacturer’s recommendations shall include methods for temporarily securing uncovered segments, connection or splicing procedures to provide continuity, and overlap requirements. At a minimum, overlap adjacent strips of geotextile grid twelve (12) inches in all directions. Tracked construction equipment shall not pass over uncovered geotextile grid. Rubber-tired equipment working atop geotextile grid shall operate at speeds less than ten (10) miles per hour and shall avoid any sudden stops or turns except in case of emergency. Repair any damage to uncovered geotextile grid at no additional cost to the City.

D. Geotextile Fabric Installation

Install geotextile fabric in accordance with the manufacturer's recommendations and AASHTO M288, Geotextile Specification for Highway Applications. The manufacturer’s recommendations shall include methods for temporarily securing uncovered segments, connection or splicing procedures to provide continuity, and overlap requirements. At a minimum, overlap adjacent strips of geotextile fabric twelve (12) inches in all directions. Tracked construction equipment shall not pass over uncovered geotextile fabric. Rubber-tired equipment working atop geotextile fabric shall operate at speeds less than ten (10) miles per hour and shall avoid any sudden stops or turns except in case of emergency. Repair any damage to uncovered geotextile fabric at no additional cost to the City.
301 Aggregate Subbase/Base Course

301.01 General

A. Description
This work includes furnishing, placing, shaping, scarifying, drying, watering, and compacting an aggregate subbase/base course to provide a firm and stable foundation for subsequent construction in accordance with the lines, grades, and cross sections indicated in the Contract Documents, or as directed by the Engineer. This work may include furnishing and installing biaxial geotextile grid and geotextile fabric.

B. Submittal Requirements
Refer to Section 300.01 B for submittal requirements.

301.02 Material Requirements

A. General
Refer to Section 300.02 for general material requirements, in addition to the following requirements.

B. Aggregate
Aggregate physical property requirements shall be in accordance with Section 300.02. The aggregate gradation shall conform to the requirements of Table 301.01.

Table 301.01
Aggregate Gradation Requirements

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Allowable Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 ½”</td>
<td>100</td>
</tr>
<tr>
<td>¾”</td>
<td>80±15</td>
</tr>
<tr>
<td>⅜”</td>
<td>53±17</td>
</tr>
<tr>
<td>#10</td>
<td>20±10</td>
</tr>
<tr>
<td>#200</td>
<td>5±5</td>
</tr>
</tbody>
</table>

301.03 Construction Requirements

A. General
Refer to Section 300.03 for general construction requirements.

301.04 Acceptance
The Engineer shall observe the work to check for compliance with the Contract Documents. Aggregate shall be constructed to the minimum compaction and thickness requirements identified in the Contract Documents. The Engineer shall verify the compaction and thickness of the aggregate in accordance with the City of Omaha Materials and Testing Manual for Public Works Construction.

301.05 Measurement and Payment
Reworking aggregate layers is subsidiary to items for which the Contract provides direct payment. Addition of water to obtain the moisture content necessary to meet compaction requirements is subsidiary to items that the Contract provides direct payment.
The Engineer shall measure aggregate subbase courses for payment by either the square yards or tons of the specified thickness of aggregate supplied, constructed, compacted, and accepted.

The Engineer shall measure aggregate base courses for payment by either the square yards or tons of the specified thickness of aggregate supplied, constructed, compacted, and accepted.

The Engineer shall measure biaxial geotextile grids for payment by the square yards of biaxial geotextile grid supplied, installed, and accepted, excluding overlap.

The Engineer shall measure geotextile fabrics for payment by the square yards of geotextile fabric supplied, installed, and accepted, excluding overlap.

Payment shall be made under the following unless otherwise indicated in the Contract Documents. The Contract Price shall be full compensation for supplying, placing, compacting, and for furnishing all labor, materials, equipment, tools, and all incidentals necessary to complete the work.

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construct ___” Aggregate Subbase Course</td>
<td>Square Yard</td>
</tr>
<tr>
<td>Construct ___” Aggregate Subbase Course</td>
<td>Ton</td>
</tr>
<tr>
<td>Construct ___” Aggregate Base Course</td>
<td>Square Yard</td>
</tr>
<tr>
<td>Construct ___” Aggregate Base Course</td>
<td>Ton</td>
</tr>
<tr>
<td>Install Biaxial Geotextile Grid</td>
<td>Square Yard</td>
</tr>
<tr>
<td>Install Geotextile Fabric</td>
<td>Square Yard</td>
</tr>
</tbody>
</table>
302 Aggregate Surface Course

302.01 General

A. Description
This work includes furnishing, placing, shaping, scarifying, drying, watering, and compacting an aggregate surface course to provide a firm and stable surface in accordance with the lines, grades, and cross sections indicated in the Contract Documents, or as directed by the Engineer. This work may also include maintenance and removal of any temporary or permanent aggregate surface course.

B. Submittal Requirements
Refer to Section 300.01 B for submittal requirements.

302.02 Material Requirements

A. General
Refer to Section 300.02 for general material requirements, in addition to the following requirements.

B. Aggregate
Aggregate physical property requirements shall be in accordance with Section 300.02. The aggregate gradation shall conform to the requirements of Table 302.01.

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Allowable Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1”</td>
<td>100</td>
</tr>
<tr>
<td>#4</td>
<td>40±20</td>
</tr>
<tr>
<td>#10</td>
<td>15±15</td>
</tr>
<tr>
<td>#200</td>
<td>5±5</td>
</tr>
</tbody>
</table>

302.03 Construction Requirements

A. General
Refer to Section 300.03 for general construction requirements, in addition to the following requirements.

B. Aggregate Surface Course
Construction requirements shall be in accordance with Section 300.03.

C. Temporary Surface Course
Aggregate surface courses used in temporary applications shall be a minimum of four (4) inches thick, unless otherwise indicated in the Contract Documents. Maintenance may include, but shall not be limited to, the placement and compaction of additional material after initial construction of the aggregate surface course.

302.04 Acceptance
The Engineer shall observe the work to check for compliance with the Contract Documents. Aggregate shall be constructed to the minimum compaction and thickness requirements identified...
in the Contract Documents. The Engineer shall verify the compaction and thickness of the aggregate in accordance with the City of Omaha Materials and Testing Manual for Public Works Construction.

302.05 Measurement and Payment

Reworking aggregate layers is subsidiary to items for which the Contract provides direct payment. Addition of water to obtain the moisture content necessary to meet compaction requirements is subsidiary to items that the Contract provides direct payment.

The Engineer shall measure aggregate surface courses for payment by either the square yards or tons of the specified thickness of aggregate supplied, constructed, compacted, and accepted.

The Engineer shall measure temporary aggregate surface courses for payment by the square yards or tons of the specified thickness of aggregate supplied, constructed, compacted, and accepted. Maintenance and removal of temporary aggregate surface courses shall be subsidiary to items for which the Contract provides direct payment.

Payment shall be made under the following unless otherwise indicated in the Contract Documents. The Contract Price shall be full compensation for supplying, placing, compacting, and for furnishing all labor, materials, equipment, tools, and all incidentals necessary to complete the work.

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construct ___” Aggregate Surface Course</td>
<td>Square Yard</td>
</tr>
<tr>
<td>Construct ___” Aggregate Surface Course</td>
<td>Ton</td>
</tr>
<tr>
<td>Construct ___” Temporary Aggregate Surface Course</td>
<td>Square Yard</td>
</tr>
<tr>
<td>Construct ___” Temporary Aggregate Surface Course</td>
<td>Ton</td>
</tr>
</tbody>
</table>
303 Recycled Asphalt Pavement (RAP) Surface and/or Base Course

303.01 General

A. Description
This work includes furnishing, placing, shaping, scarifying, drying, and compacting a recycled asphalt pavement (RAP) surface and/or base course to provide a firm and stable surface or foundation in accordance with the lines, grades, and cross sections indicated in the Contract Documents or as directed by the Engineer. This work may also include maintenance and removal of any temporary RAP surface course.

B. Submittal Requirements
Refer to Section 300.01 B for submittal requirements.

303.02 Material Requirements

A. General
Refer to Section 300.02 for general material requirements, in addition to the following requirements.

B. Recycled Asphalt Pavement
Recycled asphalt pavement (RAP) shall consist of processed asphalt pavement free of soil, brick, vegetation, metal, foreign objects or other contaminants. The maximum size of the processed material shall be two (2) inches in diameter.

303.03 Construction Requirements

A. General
Refer to Section 300.03 for general construction requirements, in addition to the following requirements.

B. RAP Placement, Compaction, and Finishing
Spread and shape the material to the profile and cross section indicated in the Contract Documents.

Compact the material in lifts not exceeding four (4) inches of compacted material. Compaction efforts shall begin upon completion of shaping. Compact material to a minimum of ninety-eight (98) percent of the maximum density in accordance with ASTM D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort. Maintain the moisture content of the RAP material in a range that facilitates achieving the required compaction.

Construct the RAP course to a thickness within one-half (½) inch of the thickness indicated in the Contract Documents. The Engineer shall conduct thickness measurements after the Contractor has completed final grading. Correct all non-conforming areas as directed by the Engineer. Scarify areas deficient in thickness to a minimum depth of three (3) inches before adding additional material.

303.04 Acceptance
The Engineer shall observe the work to check for compliance with the Contract Documents. RAP shall be constructed to the minimum compaction and thickness requirements identified in the Contract Documents. The Engineer shall verify the compaction and thickness of the RAP in accordance with the City of Omaha Materials and Testing Manual for Public Works Construction.
303.05 Measurement and Payment

Maintenance and/or removal of temporary RAP surface course shall be subsidiary to items for which the Contract provides direct payment.

Removal and disposal of any reinforcement contained within the recycled material is subsidiary to items for which the Contract provides direct payment.

The Engineer shall measure recycled asphalt pavement (RAP) surface courses for payment by the square yards of the specified thickness of surface course supplied, constructed, constructed, and accepted.

The Engineer shall measure recycled asphalt pavement (RAP) base courses for payment by the square yards of the specified thickness of base course supplied, constructed, compacted, and accepted.

The Engineer shall measure temporary recycled asphalt pavement (RAP) surface courses for payment by the square yards of the specified thickness of temporary surface course supplied, constructed, compacted, removed, and accepted.

Payment shall be made under the following unless otherwise indicated in the Contract Documents. The Contract Price shall be full compensation for supplying, installing, mixing, and furnishing all labor, materials, equipment, tools, and all incidentals necessary to complete the work.

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construct __” Recycled Asphalt Pavement Surface Course</td>
<td>Square Yard</td>
</tr>
<tr>
<td>Construct __” Recycled Asphalt Pavement Base Course</td>
<td>Square Yard</td>
</tr>
<tr>
<td>Construct __” Temporary Recycled Asphalt Pavement Surface Course</td>
<td>Square Yard</td>
</tr>
</tbody>
</table>
304 Temporary Recycled Portland Cement Concrete (PCC) Surface Course

304.01 General
A. Description
This work includes furnishing, placing, shaping, scarifying, drying, watering, and compacting a temporary recycled PCC surface course to provide a firm and stable surface in accordance with the lines, grades, and cross sections indicated in the Contract Documents, or as directed by the Engineer. This work may also include maintenance and removal of any temporary PCC surface course.

B. Submittal Requirements
Refer to Section 300.01 B for submittal requirements.

304.02 Material Requirements
A. General
Refer to Section 300.02 for general material requirements, in addition to the following requirements.

B. Recycled PCC
Physical Property requirements shall be in accordance with Section 300.02. Recycled PCC shall consist of processed PCC free of soil, brick, vegetation, metal, or foreign objects, or other contaminants.

Recycled PCC surface material shall be in accordance with ASTM D2940, Standard Specification for Graded Aggregate Material for Bases or Subbases for Highways or Airports, excluding any gradation requirements. The recycled PCC gradation shall conform to the requirements of Table 304.01.

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Allowable Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1½”</td>
<td>100</td>
</tr>
<tr>
<td>#4</td>
<td>40±20</td>
</tr>
<tr>
<td>#10</td>
<td>15±15</td>
</tr>
<tr>
<td>#200</td>
<td>2.5±2.5</td>
</tr>
</tbody>
</table>

304.03 Construction Requirements
A. General
Refer to Section 300.03 for general construction requirements, in addition to the following requirements.

B. Recycled PCC Placement, Compaction, and Finishing
Spread and shape the material to the profile and cross section indicated in the Contract Documents.

Compact the material in lifts not exceeding four (4) inches of compacted material. Compaction efforts shall begin upon completion of shaping.
Compact material to ninety-eight (98) percent of the maximum density in accordance with ASTM D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort. Maintain the moisture content of the recycled PCC material in a range that facilitates achieving the required compaction.

Construct the recycled PCC course to a thickness within one-half (½) inch of the thickness indicated in the Contract Documents. The Engineer shall conduct thickness measurements after the Contractor has completed final grading. Correct all non-conforming areas as directed by the Engineer. Scarify areas deficient in thickness to a minimum depth of three (3) inches before adding additional material.

304.04 Acceptance
The Engineer shall observe the work to check for compliance with the Contract Documents. Temporary recycled PCC shall be constructed to the minimum compaction and thickness requirements identified in the Contract Documents. The Engineer shall verify the compaction and thickness of the recycled PCC in accordance with the City of Omaha Materials and Testing Manual for Public Works Construction.

304.05 Measurement and Payment
Maintenance and/or removal of temporary recycled PCC surface course shall be subsidiary to items for which the Contract provides direct payment.

Removal and disposal of any reinforcement contained within the recycled material is subsidiary to items for which the Contract provides direct payment.

The Engineer shall measure temporary recycled PCC surface courses for payment by the square yards of the specified thickness of temporary surface course supplied, constructed, compacted, removed, and accepted.

Payment shall be made under the following unless otherwise indicated in the Contract Documents. The Contract Price shall be full compensation for supplying, installing, compacting, and for furnishing all labor, materials, equipment, tools, and all incidentals necessary to complete the work.

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construct __” Temporary Recycled PCC Surface Course</td>
<td>Square Yard</td>
</tr>
</tbody>
</table>
305 Perforated Underdrain Pipes

305.01 General
   A. Description
   This work includes furnishing and installing pipe underdrains, filter fabric, and underdrain headwalls in accordance with the lines, grades, and cross sections indicated in the Contract Documents, or as directed by the Engineer.

   B. Submittal Requirements
   Refer to Section 300.01 B for submittal requirements.

305.02 Material Requirements
   A. General
   Refer to Section 300.02 for general material requirements, in addition to the following requirements.

   B. Perforated Underdrain Pipe

   C. Granular Backfill Material
   Aggregate used for granular backfill material shall conform to the gradation requirements of Table 305.01. Aggregate shall be washed and composed of clean, hard, durable, and uncoated particles. Aggregates produced from wet pits by pumping will be considered to be washed. Aggregates from a dry pit shall have a method for washing. Aggregate shall have a soundness loss of not more than twelve (12) percent by weight at the end of five (5) cycles using a sodium sulfate solution.

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Allowable Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1&quot;</td>
<td>100</td>
</tr>
<tr>
<td>¾&quot;</td>
<td>98±2</td>
</tr>
<tr>
<td>#10</td>
<td>23±8</td>
</tr>
<tr>
<td>#50</td>
<td>5±5</td>
</tr>
<tr>
<td>#200</td>
<td>2±2</td>
</tr>
</tbody>
</table>

305.03 Construction Requirements
   A. General
   Refer to Section 300.03 for general construction requirements, in addition to the following requirements.

   B. Trench Excavation
   Trenching for underdrain pipe shall be performed after earth shoulder construction is complete to limit the damage to the pipe and prior to permanent seeding. The soil excavated from the
trench shall be windrowed along the trench then backfilled and bladed to the shoulder slope shown in the plans the same day. Trenches shall not remain open overnight.

The trench for laying the underdrains shall be cut to the depth and width as shown in the Contract Documents. The trench shall provide positive drainage to the outlet.

C. Underdrain Pipe Installation

The Contractor shall place filter fabric as shown in the Contract Documents. Filter fabric shall be considered subsidiary to other items for which direct payment is made.

The perforated underdrain pipe shall be laid on approximately one (1) inch of the granular backfill material. Granular backfill material shall then be filled to bottom of the new pavement. Contractor shall perform compaction efforts using mechanical methods. Granular backfill material shall be considered subsidiary to other items for which direct payment is made.

Dead ends of pipe shall be tightly closed with plugs. Discharge ends shall be protected with rodent screens.

If unsuitable foundation soils are present, other suitable material shall be placed under the pipe to prevent displacement. Once the pipe is placed, it shall be covered immediately with the granular material.

Special inlets and special devices at the outlet end of the pipe shall be constructed as shown in the Contract Documents.

Underdrain headwalls shall be constructed in accordance with Section 500.

305.04 Acceptance

The Engineer shall observe the work to check for compliance with the Contract Documents.

305.05 Measurement and Payment

The Engineer shall measure perforated underdrain pipes for payment by the linear feet of the size of perforated underdrain pipe supplied, constructed, excavated, bedded, backfilled, and accepted. Rodent screens shall be considered incidental to items for which direct payment is made. The Engineer shall conduct measurements along the horizontal surveyed centerline of all perforated underdrain pipes from center to center of structure for all inlets and manholes.

The Engineer shall measure underdrain headwalls for payment by each underdrain headwall constructed, backfilled, and accepted.

Payment shall be made under the following unless otherwise indicated in the Contract Documents. The Contract Price shall be full compensation for supplying, installing, compacting, backfilling, and for furnishing all labor, materials, equipment, tools, and all incidentals necessary to complete the work.

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construct ___” Perforated Underdrain Pipe</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Construct Underdrain Headwall</td>
<td>Each</td>
</tr>
</tbody>
</table>
SECTION 400 – FLEXIBLE PAVEMENTS

400 Flexible Pavements

400.01 General
A. Description
The information, submittal requirements, material requirements, and construction requirements shall apply to all subsections within Section 400 unless otherwise specified. This section includes surface preparation, asphalt concrete pavement (ACP), asphalt pavement repair, and crack repair.

B. Submittal Requirements
The Contractor shall submit, in accordance with the General Conditions, the following submittals. Unless otherwise stated in the Contract Documents, all submittals shall be provided a minimum of seven (7) calendar days prior to the start of work:

1. Flexible pavement mix design.
2. Flexible pavement quality control program.
3. Flexible pavement component materials, certifications, test properties, source properties, and a Material Safety Data Sheet (MSDS) if applicable.
4. Emulsified or cutback tack material certifications, test properties, and a Material Safety Data Sheet (MSDS).
5. Asphalt release agent material certifications and a Material Safety Data Sheet (MSDS).
6. Pavement fabric reinforcement including manufacturer’s application recommendations, product specifications and properties.
7. Crack sealing compound material certifications and manufacturer’s application recommendations.

400.02 Material Requirements
A. Coarse Aggregate Source Properties
Coarse aggregate shall conform to all material property requirements in accordance with ASTM D692, Standard Specification for Coarse Aggregate for Bituminous Paving Mixtures; and shall conform to the requirements for Table 3, Class 4S in accordance with ASTM C33, Specification for Concrete Aggregates, excluding any crushed particle or gradation requirements. Crush and grade coarse aggregate as needed to meet the required material properties.

B. Fine Aggregate Source Properties
Fine aggregate shall conform to all material property requirements in accordance with ASTM C33, Specification for Concrete Aggregates; and ASTM D1073, Standard Specification for Fine Aggregate for Bituminous Paving Mixtures, excluding any crushed particle or gradation requirements. Crush and grade fine aggregate as needed to meet the required material properties.
C. Mineral Fillers

Mineral fillers added separate of coarse and fine aggregates shall be in accordance with ASTM D242, Standard Specification for Mineral Filler for Bituminous Paving Mixtures.

400.03 Construction Requirements

A. Production Facilities

The Engineer may inspect any production facility that intends to provide asphalt or other flexible pavement or component materials. The Engineer may reject any material produced from the facility if deficiencies deemed detrimental to the material quality are identified. The Contractor shall provide plant scale calibration documentation upon request.

B. Equipment

All equipment, tools, and machinery used in the work shall be maintained in accordance with the manufacturer’s recommendations. The Engineer may reject the use of any equipment, tools, or machinery which is not working properly or functioning as it is intended.

C. Barricades

Post flag persons, barricades, and warning signs in accordance with the City of Omaha Barricading Standards, Specifications, Methods, and Materials Manual, the Manual on Uniform Traffic Control Devices (MUTCD), and Section 900. All barricades, warning signs, and flag persons shall be in place before any work shall be permitted to start. All traffic control devices shall be continuously monitored, moved, reset, and/or replaced to provide the orderly movement of traffic through or around the work site. All installation, removal, or any modifications of traffic control shall be performed by the Contractor.
401  Asphaltic Concrete Pavement

401.01  General

A.  Description

This work includes the construction of one or more courses of hot-mixed, hot laid, Asphaltic Concrete Pavement (ACP) on a prepared subgrade, sub-base, base, or existing surface to the lines, grades, and typical cross sections indicated in the Contract Documents or as directed by the Engineer.

B.  Submittal Requirements

Refer to Section 400.01 B for submittal requirements.

401.02  Material Requirements

A.  General

Refer to Section 400.02 for general material requirements, in addition to the following requirements.

B.  Asphalt Mixes and Performance Graded Binders

Table 401.01 shall be used as a guide to determine the appropriate mix or mixes to be used for constructing asphalt pavements or overlays. In the event of a discrepancy with the bid items stated for a proposed ACP, the bid item type specified shall govern.

<table>
<thead>
<tr>
<th>Type</th>
<th>Lift Thickness</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPR</td>
<td>&gt;1.5&quot;</td>
<td>Overlays or Surface Course for Collector Streets, Local Roads, and Parking Lots or Driveways with Commercial Truck Traffic</td>
</tr>
<tr>
<td>SPR Fine or SLX</td>
<td>&lt;1.0&quot;</td>
<td>Leveling/Wedge Course and Thin Lift Overlays or Surface Course for Collector Streets, Local Roads, and Parking Lots or Driveways with Commercial Truck Traffic</td>
</tr>
<tr>
<td>SPH Fine</td>
<td>&lt;1.5&quot;</td>
<td>Overlay or Surface Course for Arterials Streets, Central Business District Streets, Truck Routes, and Parking Lots or Driveways with Commercial Truck Traffic</td>
</tr>
<tr>
<td>SPH</td>
<td>&gt;1.5&quot;</td>
<td>Overlay or Surface Course for Arterials Streets, Central Business District Streets, Truck Routes, and Parking Lots or Driveways with Commercial Truck Traffic</td>
</tr>
</tbody>
</table>

Unless otherwise indicated in the Contract Documents, asphalt pavement mix designs and standards shall be in accordance with Tables 401.02 and 401.03. Asphaltic Concrete mix designs shall be developed in accordance with AASHTO T312, Standard Method of Test for Preparing and Determining the Density of Asphalt Mixture Specimens by Means of the Superpave Gyratory Compactor. The mixture for the Superpave specimens and maximum specific gravity mixture shall be aged for two (2) hours at compaction temperature in accordance with AASHTO R30, Standard Practice for Mixture Conditioning of Hot Mix Asphalt (HMA).
### Table 401.02
Combined Asphalt Pavement Material Properties

<table>
<thead>
<tr>
<th>Mix Type/Designation</th>
<th>SPR</th>
<th>SPR (Fine)</th>
<th>SLX</th>
<th>SPH Fine</th>
<th>SPH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coarse Aggregate Crushed Particle</td>
<td></td>
<td>83% min.</td>
<td></td>
<td>Min. 95/90%³</td>
<td></td>
</tr>
<tr>
<td>Uncompacted Void Content of Fine Aggregate</td>
<td></td>
<td>43.0% min.</td>
<td></td>
<td>45.0% min.</td>
<td></td>
</tr>
<tr>
<td>Flat/Elongated Pieces (5:1 Ratio)</td>
<td></td>
<td></td>
<td></td>
<td>10% max.</td>
<td></td>
</tr>
<tr>
<td>Sand Equivalent</td>
<td></td>
<td></td>
<td></td>
<td>45 min.</td>
<td></td>
</tr>
<tr>
<td>Sodium Sulfate Loss @ 5 cycles⁵</td>
<td></td>
<td></td>
<td></td>
<td>12% max.</td>
<td></td>
</tr>
<tr>
<td>Clay Lumps, Shale, and Soft/Friable Particles</td>
<td></td>
<td>3.5% max.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dust (% -#200 material) to Produced Binder Ratio</td>
<td></td>
<td>0.7 - 1.7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Film Thickness, microns⁶</td>
<td></td>
<td>9.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RAP, % By Total Wt. Of Mix</td>
<td></td>
<td>25 max.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tensile Strength Ratio, %</td>
<td></td>
<td>80.0 min.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mix Design Air Voids, %</td>
<td></td>
<td>Target 3.0</td>
<td></td>
<td>Target 4.0</td>
<td></td>
</tr>
<tr>
<td>Compaction Gyrations Ninitial</td>
<td>7</td>
<td></td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compaction Gyrations Ndesign</td>
<td>65</td>
<td>50</td>
<td>95</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compaction Gyrations Nmaximum</td>
<td>100</td>
<td></td>
<td>150</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Production Binder Content (% of Total Mix)⁷</td>
<td>5.0 min.</td>
<td>5.3 min.</td>
<td>5.3 min.</td>
<td>5.3 min.</td>
<td>5.1 min.</td>
</tr>
<tr>
<td>Production Air Voids, %</td>
<td>2.0 – 4.0</td>
<td>3.0 – 5.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In-Place Compaction (% of Gmm)</td>
<td></td>
<td>92.5 min.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. Type SLX shall contain a minimum of 20% Crushed Rock Chips with a minimum of 45% retained on the #4 sieve and a maximum of 5% passing the #200 sieve
2. Coarse aggregate angularity shall be determined by ASTM D5821, Standard Test Method for Determining the Percentage of Fractured Particles in Coarse Aggregate
3. "95/90" denotes that 95% of the coarse aggregate has one or more fractured faces and 90% has two or more fractured faces
4. Fine aggregate angularity shall be determined by AASHTO T304, Standard Method of Test for Uncompacted Void Content of Fine Aggregate
5. Requirement applies to the individual aggregates as well as the combined aggregates and RAP (if applicable)
6. Film Thickness shall be determined by Minnesota DOT procedure 1854.0, Adjusted Asphalt Film Thickness.
7. A maximum of twenty (20) percent of the total binder shall be derived from the RAP as determined by dividing the calculated binder contribution from the RAP by the total production binder content as determined by Contractor QC and Verification Testing.
### Table 401.03
Asphalt Pavement Material Properties

<table>
<thead>
<tr>
<th>Mix Type</th>
<th>SPR</th>
<th>SPR Fine</th>
<th>SLX</th>
<th>SPH Fine</th>
<th>SPH</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Passing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3/4”</td>
<td>98.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
</tr>
<tr>
<td>1/2”</td>
<td>98.0</td>
<td>100.0</td>
<td>98.0</td>
<td>100.0</td>
<td>98.0</td>
</tr>
<tr>
<td>3/8”</td>
<td>81.0</td>
<td>89.0</td>
<td>81.0</td>
<td>96.0</td>
<td>93.0</td>
</tr>
<tr>
<td>#4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>#8</td>
<td>46.0</td>
<td>56.0</td>
<td>46.0</td>
<td>56.0</td>
<td>45.0</td>
</tr>
<tr>
<td>#16</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>#30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>#50</td>
<td>12.0</td>
<td>21.0</td>
<td>12.0</td>
<td>21.0</td>
<td>10.0</td>
</tr>
<tr>
<td>#200</td>
<td>4.0</td>
<td>9.0</td>
<td>9.0</td>
<td>9.0</td>
<td>4.0</td>
</tr>
</tbody>
</table>

Coarse aggregate is the total material retained on the #4 sieve. Fine aggregate is the total material passing the #4 sieve and retained on the #200 sieve.

The bulk specific gravity (Gsb) shall be two and five-hundred eighty-five thousandths (2.585) for all mixes, and shall be used for data purposes and information only. The binder content shall be determined by ignition oven results. A correction factor of three-tenths (0.3) percent shall be added to the ignition oven results for mixes containing hydrated lime, and an adjustment factor of one-tenth (0.1) percent will be added to the ignition oven results for mixes containing warm mix additive (WMA).

The specific gravity for calculation of the Fine Aggregate Angularity (FAA) shall be determined on a washed combined aggregate sample of the material passing the #8 sieve and retained on the #100 sieve. The Contractor will determine the specific gravity to be used in the calculation of FAA mixture design value(s) and, if verified by the Engineer, this same value can be used throughout production. The verification value verified by the Engineer will be on a combined aggregate sample supplied by the Contractor that is representative of the material proposed or being used during production. The specific gravity to be used throughout production to calculate FAA values will be the Contractor’s verified value and shall be noted on the Mix Design. Changes in aggregate percentages during production may require determination of a revised specific gravity for FAA.

Chat or coal sand shall not be allowed in any mix.

Mixes containing less than eighty (80) percent limestone by weight of virgin material shall contain a minimum of one and twenty-five hundredths (1.25) percent hydrated lime. Each mix type shall be tested for moisture sensitivity in accordance with AASHTO T283, Standard Method of Test for Resistance of Compacted Asphalt Mixtures to Moisture-Induced Damage. Six (6) inch test specimens shall be compacted in accordance with AASHTO T312, Standard Method of Test for Preparing and Determining the Density of Asphalt Mixture Specimens by Means of the Superpave Gyratory Compactor, to six and one-half (6.5) to seven and one-half (7.5) percent air voids at ninety-five (95) millimeters in height and evaluated to determine the Tensile Strength Ratio (TSR). The Contractor shall add hydrated lime or an anti-stripping agent as needed to satisfy TSR requirements.
The Contractor shall provide the data points, target production settings, and confirm the submitted mix design addresses all mix requirements and complies with the acceptance criteria. The mix design shall be provided in writing a minimum of fourteen (14) calendar days prior to the start of milling operations for resurfacing projects or prior to the start of site grading. The submitted mix design shall provide sources, source quality properties, individual gradation and binder content (if applicable) for all aggregate and RAP materials used. When requested, component materials shall be provided to allow for the Engineer to perform a mix design verification.

In RAP mixtures, the maximum allowable percent of RAP shall be twenty-five (25) percent. The total amount of recycled binder provided from the RAP shall not exceed twenty (20) percent of the total binder content determined as a percentage of total mix. The binder content of the RAP shall be determined by using the same procedures as is used for determining total binder content of the as-produced mix. No correction factor shall be applied.

The Contractor shall inform the Engineer when changes in mixture properties or materials used occur for any reason. Changes may include, but are not limited to, types or sources of aggregates or changes in grades, sources, properties or modification procedures (if modified) of PG Binders. The Engineer may require a new job mix formula, mix design and moisture sensitivity test. The new proposed job mix formula shall be in accordance with the requirements as stated above.

Mix adjustments for individual aggregates, including RAP, greater than twenty-five (25) percent of the original verified mix design proportion or greater than five (5) percent change in the original verified mix design percentage, whichever is greater, may require the Contractor to submit a new mix design, as determined by the Engineer. The Contractor shall be responsible for requesting new mix design targets as they approach these tolerances, and failure to do so may result in a suspension of operations until a new mix design is reviewed by the Engineer.

C. Bituminous Tack Coat

Bituminous tack coat material shall conform to the requirements of CSS-1 or CSS-1h in accordance with ASTM D2397, Standard Specification for Cationic Emulsified Asphalt. The maximum water dilution shall be fifty (50) percent.

D. Asphalt Release Agent

Asphalt release agent shall consist of a detergent solution or other non-petroleum, non-solvent solution.

E. Asphalt Mixes and Performance Graded Binders

The binder type to be used for construction asphalt pavements and overlays shall be either PG64-34 or 58V-34 unless otherwise indicated in the Contract Documents. A warm mix additive shall be included in all asphalt binders unless otherwise waived in writing by the Engineer. The Contractor shall follow the manufacturer’s recommended dosing for the warm mix additive.

The supplier of performance graded (PG) binders shall be certified by the Nebraska Department of Transportation (NDOT). Performance graded binders shall be in accordance with AASHTO M320, Standard Specification for Performance-Graded Asphalt Binder, excluding direct tension. Blending of performance graded binders shall not be allowed.

If the ambient air temperature is anticipated to be at or below fifty-five (55) degrees Fahrenheit during production or placement of the asphalt, the Contractor shall utilize a PG binder.
F. Anti-Stripping Agents

Anti-stripping agents shall be on the Nebraska Department of Transportation (NDOT) Approved Product List (APL). The Contractor shall follow the manufacturer’s recommendations for incorporating the anti-stripping agent into the mix.

G. Recycled Asphalt Pavement (RAP)

RAP material shall consist entirely of ACP materials. Remove all concrete, brick, soil, or other contaminants. The Contractor is responsible for investigating and maintaining the quality and verifying the quantity of the RAP material. The RAP must be pre-processed by fractionating, screening, and/or crushing prior to use to a size such that the combined hot mix meets the required gradation and the RAP maintains a consistent gradation and asphalt binder content. All processed material shall be less than two (2) inches in diameter before the Contractor introduces such material into the mixing chamber. Screen RAP material using a screen with a nominal two (2) inch diameter opening immediately before introducing such material into the mixing chamber. Do not place any equipment on stockpiles of processed material.

All RAP incorporated into the project shall come from a documented RAP Source (controlled stockpile location). A controlled stockpile location shall be a designated pile made up of asphalt roadway millings and/or a stockpile of controlled crushed asphalt material. Prior to production, the Contractor shall submit representative sampling test results showing gradation, AC content, and component aggregate classification or source for all proposed RAP sources for review by the Engineer. The Contractor shall notify the Engineer prior to changing RAP sources and test results shall be submitted in writing.

RAP materials shall conform to the requirements of Table 401.04.

<table>
<thead>
<tr>
<th>Property</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ignition Binder Content</td>
<td>Mix Design Value ±0.5%</td>
</tr>
<tr>
<td>Fine Aggregate Angularity</td>
<td>42 min.</td>
</tr>
<tr>
<td>Coarse Agg. Angularity, 1 Face</td>
<td>80% min.</td>
</tr>
<tr>
<td>Coarse Agg. Angularity, 2 or more Faces</td>
<td>75% min.</td>
</tr>
<tr>
<td>Percent Passing 3/4&quot; Sieve</td>
<td>90% min.</td>
</tr>
<tr>
<td>Percent Passing #200 Sieve</td>
<td>8% max.</td>
</tr>
</tbody>
</table>

The Engineer reserves the right to reject a RAP source or stockpile.

H. Recycling Agents

Recycling agents shall be in accordance with ASTM D4552, Standard Practice for Classifying Hot-Mix Recycling Agents.

I. Crack Sealant

Crack sealant shall be a hot applied bitumastic liquid material intended for use on asphaltic concrete pavement, and shall be in accordance with ASTM D6690, Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.

J. ACP Quality Control Program and Testing

The Contractor shall develop and submit a Quality Control (QC) Program to the Engineer a minimum of one (1) week prior to the start of milling operations. The submittal shall include:
• QC organization chart.
• QC testing plan for plant production.
• QC plan for materials delivery, materials storage, and production scheduling.
• Documentation of QC activities.
• Documentation of any corrective action when QC or acceptance criteria are not met.
• Any additional elements deemed necessary.

The QC program shall detail the methods and procedures that will be taken to verify the work meets the requirements of the Contract Documents. Procedures shall be defined to perform corrective action when any mix properties are out of specification should plant and production problems occur, or should laydown problems occur, including: rutting, segregation, surface voids, tearing, contamination, irregular surfaces, and surface irregularities. The QC program shall be updated and submitted to the Engineer at least annually. A copy of the QC program shall be kept on file in the QC lab.

The Contractor shall perform quality control testing in accordance with NDOT standard sampling and test procedures at the frequencies identified herein. Quality control testing shall be performed by an NDOT certified or nationally accredited testing laboratory and by personnel certified by NDOT in relevant asphalt quality testing procedures. The Contractor may add any tests deemed necessary to control production. Unless otherwise indicated in the Contract Documents, testing requirements, frequencies, tolerances, and reporting procedures shall be as stated herein. All instances of providing test results, certifications, or materials shall be understood to mean requiring these items be submitted to the Engineer.

The Contractor shall calibrate and correlate the testing equipment according to the procedures described for the individual tests and conduct tests in conformance with specified testing procedures. All QC test results shall be reported by the Contractor using the latest version of the City’s Asphalt Pay Factor Excel workbook or as directed by the Engineer, and within forty-eight (48) hours after the tests are complete or by the start of production on the second business day following the sampling event. Test results not provided as required may result in Owner withholding all or part of the progress payments and suspension of all milling and paving operations, unless otherwise directed by the Engineer.

At the completion of the asphalt production, the Contractor shall submit to the Engineer a final copy of the QC test results on electronic recording media (CD, e-mail, flash drive, etc.).

The Contractor shall sample and provide quality control testing for performance grade binders, volumetric properties, combined aggregate consensus properties, gradation, thickness, and compaction testing. A representative split of all quality control samples shall be provided to the Engineer for quality assurance testing upon request. The split sample shall be sufficiently sized to perform all associated testing.

A cold feed sample shall be taken and tested for gradation, FAA, and CAA when requested by the Engineer. When cold feed samples are being taken, the acquisition shall be timed such that the material in the sample represents the same material in the sample taken behind the paver. The Contractor shall submit a split of the sample with the hot mix sample. Samples shall be taken under the observation of the Engineer and split in accordance with AASHTO T248, Standard Method of Test for Reducing Samples of Aggregate to Testing Size.
For projects using RAP material, the FAA shall be established as follows: a RAP sample will be processed through an ignition oven and then combined with the proportioned amount of virgin aggregate defined by the mix design and then proceeding with FAA and CAA testing.

For projects with multiple contract defined segments or locations, or using multiple mixes on the same segment or location, each segment, location, and mix type shall be treated separately when multiple segments, locations, and mixes are paved on the same day. A minimum of one (1) hot mix sample shall be obtained from each segment or location for each half-day of production on that segment or location per mix type, also referred to herein as a sample area.

A half-day of production for the purposes of defining the sample area shall consist of the area within a segment or location where construction occurs for up to six (6) consecutive hours. A day’s production is considered the asphalt constructed during a continuous, defined daytime or nighttime paving timeslot. Continuous paving operations beginning in an evening and extending past midnight into early morning hours shall be considered a day’s production. Temporary stops for production interruptions, equipment breakdown, weather, or other unforeseen conditions may be included in the half-day determination as determined by the Engineer.

If production exceeds six (6) consecutive hours, then a second sample shall be obtained, tested, and the results used in combination with the first daily sample as identified herein. If an unforeseen condition halts paving operations for the daytime or overnight period prior to a sample being obtained, the Engineer shall determine whether to include the untested sample area and material in the preceding or upcoming sample area for determining acceptance and payment.

The Contractor shall provide RAP quality control test results for every day of asphalt material produced for each certified RAP source being used unless otherwise directed by the Engineer. Samples shall be randomly obtained from the stockpile or obtained from the material conveyance belt during production of asphalt, or as directed by the Engineer. The Contractor shall obtain two (2) separate samples of at least twenty (20) pounds at the same time and provide one (1) to the Engineer to be used for Quality Assurance verification testing at the Engineer’s discretion.

The Contractor or supplier shall provide producer-certified quality control binder test results for every calendar week of asphalt material produced for the project. The Contractor shall randomly sample asphalt binder from the production supply line during production of the asphalt material. The Engineer shall be notified to allow for observation of the sampling at the plant. Three (3) separate containers for each sample shall be taken and two (2) shall be provided to the Engineer. One (1) container will be for quality assurance testing by a qualified laboratory, one (1) container will be for quality control testing by the Contractor, and the final container shall be retained by the Engineer for re-testing in case of conflicting results. The Engineer shall identify one (1) asphalt binder sample for every ten-thousand (10,000) tons of ACP placed, maximum of three (3) for each project, to be tested by the Contractor for quality control purposes to demonstrate the binder meets or exceeds the requirements. Results of the quality control test shall be provided electronically to the Engineer within fourteen (14) days of sampling. If there is a conflict between the results provided and the Engineer’s Quality Assurance testing, the retained sample shall be sent to an independent third party, agreeable to both parties, for further testing. If non-compliant results are identified, the Engineer may require testing of all production binder samples to determine the extent of the non-compliance.
Although guidelines are established and certain minimum requirements are specified herein and elsewhere in the Contract Documents, the Contractor shall assume full responsibility for constructing a pavement that meets the Contract Documents requirements.

The Contractor shall notify the Engineer whenever a test result approaches the acceptance limits.

All QC testing, including binder testing, is subsidiary to items for which the Contract provides direct payment.

K. ACP Quality Assurance Testing

The Engineer will select and test up to twenty-five (25) percent of the split samples to verify the results of the Contractor QC testing. Any samples outside of the tolerance requirements in Tables 401.05 and 401.06 shall result in an Independent Assurance (IA) review of testing and may result in the rejection of the material.

On any given sample, if the results of verification testing and its companion QC testing are within the tolerance shown below, the verification for the Contractor QC for those sample areas of paving is complete and the Contractor test results will be used to determine the pay factors. If the verification test results and the companion QC test results are outside the tolerance, the results from the verification test will be used to determine the pay factor for that day’s paving. When directed by the Engineer, any of the remaining samples within segment or location may be tested and the verification sample test results may be applied to the respective day’s production to determine the pay factors to be used.

When verification tests are within testing tolerance, but results show a consistent pattern of deviation from the QC results, or there is a consistent pattern of non-correlation between the QC and verification tests, the Engineer may cease production and initiate a comprehensive IA review to determine corrective action needed prior to resuming production.

<table>
<thead>
<tr>
<th>Test</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asphalt Content by Ignition Oven</td>
<td>0.5%</td>
</tr>
<tr>
<td>Gyratory Density</td>
<td>0.020</td>
</tr>
<tr>
<td>Maximum Specific Gravity</td>
<td>0.015</td>
</tr>
<tr>
<td>Bulk Dry Specific Gravity (Gsb)</td>
<td>0.020</td>
</tr>
<tr>
<td>FAA</td>
<td>0.7%</td>
</tr>
<tr>
<td>CAA</td>
<td>10%</td>
</tr>
<tr>
<td>Field Core Density</td>
<td>0.020</td>
</tr>
<tr>
<td>Air Voids</td>
<td>1.0%</td>
</tr>
<tr>
<td>Asphalt Film Thickness</td>
<td>0.4</td>
</tr>
</tbody>
</table>
Table 401.06
Blended Aggregate Gradation Verification Testing Tolerances

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/4 inch (19 mm), 1/2 inch (12.5 mm), 3/8 inch (9.5 mm), No. 4 (12.5 mm), No. 8 (2.36 mm)</td>
<td>6%</td>
</tr>
<tr>
<td>No. 16 (1.18 mm), No. 30 (600 µm), No. 50 (300 µm)</td>
<td>5%</td>
</tr>
<tr>
<td>No. 200 (75 µm)</td>
<td>3%</td>
</tr>
</tbody>
</table>

L. Independent Assurance (IA) Review of Testing

The Contractor shall provide the Engineer access to their laboratory to conduct an Independent Assurance (IA) review of technician testing procedures and apparatus. Deficiencies discovered in testing procedures will be reported by the Engineer and corrected by the Contractor.

During an IA review, the Engineer and the Contractor will split a sample for the purpose of IA testing. The samples selected will be tested by the Engineer. Any IA test results found to be outside of defined testing tolerances will be reported. The Contractor shall verify the testing apparatus and make corrections if the apparatus is out of tolerance.

It is the Contractor’s responsibility to obtain a large enough sample size for any referee testing (a sample size of six-thousand (6,000) grams, to be retained by the Engineer after splitting, is recommended for FAA testing).

401.03 Construction Requirements

A. General

Refer to Section 400.03 for general construction requirements, in addition to the following requirements. The Contractor shall not begin any milling operations, pavement repairs, or construction of asphalt pavements or production of materials until the QC program has been reviewed by the Engineer.

No milling, surface preparation, base repairs, or other activities requiring a traffic restriction or closure shall commence until the Engineer has reviewed the mix design.

B. Equipment

1. Milling Machines

Milling machines shall have automatic controls for establishing profile grades on each side of the machine using the existing pavement and/or a taut reference line. Milling machines shall be equipped to provide a vertical milled surface to within eight (8) inches from the back of the curb. Milling machines shall have the ability to reference the existing pavement using a self-contained system that incorporates twenty-five (25) feet of existing pavement and compensates for humps or depressions three (3) feet or less in length. Milling machines shall be able to remove the milled material from the surface using a loading elevator.

The Contractor shall utilize a ski attachment, or similar device, to control the profile of the milled surface in all areas greater than fifty (50) feet from roadway intersections on all arterial or collector streets as classified by the Federal Function Classification. The use of a wheel, matching shoe, or other device to solely control the depth or profile of the milled
surface shall not be permitted. The ski attachment shall be a minimum of ten (10) feet in length.

2. **Asphalt Mixing Plant**

   The asphalt mixing plant shall produce uniform asphalt mix in accordance with the Contract Documents. For batch plants, the minimum dry mixing period shall be five (5) seconds and the minimum wet mixing period shall be twenty-five (25) seconds. All mixing plants shall have automatic controls for proportioning, timing, and discharge.

   The plant shall heat and dry the aggregates to the appropriate mixing temperature before introducing the PG binder. Regulate the heat applied to the aggregates to avoid damage or contamination. Continuously supply heated PG binder to the aggregate materials during mixing. Mixing shall continue until the PG binder has uniformly coated at least ninety-five (95) percent of the aggregate materials when tested in accordance with ASTM D2489, Standard Test Method for Degree of Particle Coating of Bituminous-Aggregate Mixtures.

   Store ACP mix to avoid segregation or excessive heat loss. ACP mix that has segregated or experienced excessive heat loss shall be deemed unacceptable. Storage tanks shall be equipped with a circulating system designed to provide proper and continuous circulation of the asphalt materials during the operating period. Polymer modified asphalt binder storage tanks shall be equipped with an agitator to maintain uniform dispersion of the additive and shall be operated at all times.

3. **Hauling Equipment**

   Transport the ACP mixture in vehicles with tight, clean, and smooth metal beds. The Contractor may lightly coat the bed with an asphalt release agent. Do not coat the bed with petroleum oils, solvents, or other material. Cover all loads during adverse weather conditions or when atmospheric temperatures are below sixty-five (65) degrees Fahrenheit. Insulate the sides of the truck beds between October 15th and March 15th.

4. **Asphalt Paving Machines**

   Asphalt paving machines shall be self-propelled with a heated and vibrating screed capable of uniformly spreading and finishing the ACP mixture to the specified section width and thickness. The screed shall strike off the asphalt surface without tearing, shoving, or gouging the ACP mixture. The screed shall have an electronic control to automatically regulate slope and grade adjustments. The self-contained reference system shall detect and compensate for a variation of one-eighth (⅛) inch along the reference line and a variation of one-eighth (⅛) inch in slope within a twelve (12) foot wide lane. The screed and extensions shall be adjustable to the specified crown and mat thickness. The screed unit and any extensions shall have vibrators or tamper bars and heaters throughout the entire length. Controls for the temperature of the screed shall be adjustable to prevent overheating or damage to the ACP mixture.

   A ski attachment, or similar device, shall be utilized to control the profile of the finished surface in all areas greater than fifty (50) feet from roadway intersections on all roadways classified as arterials or collectors by the Federal Function Classification. The use of a wheel, matching shoe, or other devices to solely control the depth of profile of the finished surface is not permitted. The ski shall be a minimum of twenty (20) feet long. A ski shall be used during paving operations if a ski was not used during cold planing operations. The Engineer may require a ski attachment at any time during the paving operation.
A material transfer vehicle (MTV) may be used to deliver the ACP mixture to the asphalt paver. The MTV shall deliver material to the paver without causing segregation.

5. **Compaction Equipment**

Compaction equipment shall consist of a minimum of three (3) steel drum vibratory rollers per paving operation, of which at least two (2) shall have dual drums with a minimum drum diameter of sixty (60) inches. Additionally, vibratory rollers shall have enough weight to accomplish initial compaction of the ACP to the required density without causing undue displacement, cracking, or shoving. All rollers shall be capable of reversing without shoving or tearing the asphalt mixture. Vibratory rollers shall have separate energy and propulsion controls.

The Contractor shall establish the rolling patterns for the combination(s) of rollers provided to properly construct the ACP lift while the mixture is in a workable condition. Combination steel drum-rubber tire rollers shall not be used for initial compaction. There shall always be a minimum of two (2) rollers performing compaction operations. Paving operations shall immediately cease if a required dual steel drum roller is not available regardless of the quantity of mix on-site or already produced.

Areas inaccessible to the required compaction equipment shall be compacted using equipment capable of providing the required density and finished surface. A vibratory plate or hand plate compactor shall not be used.

C. **Pavement Repair**

The method of pavement repair shall be in accordance with the Contract Documents or as directed by the Engineer.

1. **Asphalt Concrete for Pavement Repair**

   Full depth saw cut to the removal limits identified by the Engineer. Remove and dispose of unstable or deteriorated base course, bituminous surfacing, armor coat, bituminous patching material, concrete, brick, cobblestone, or other pavement in accordance with Section 100.

   Perform subgrade preparation and any removal and replacement of unsuitable material in accordance with Section 200. Replace or reconstruct the removed materials with one (1) or more courses of hot-mixed and hot-laid ACP.

   Asphalt Concrete for Pavement Repair shall be Type SPH or SPR. The repair area shall be of a minimum width to allow for compaction with a mechanical roller. Vibratory plates shall not be used. Each lift of ACP material shall not exceed four (4) inches of compacted material. Each lift shall be allowed to cool a minimum of two (2) hours before applying the tack coat and construction of subsequent lifts or before the final ACP surface is constructed. The minimum depth of pavement repair shall be nine (9) inches or equivalent to the thickness of the existing pavement plus two (2) inches, whichever is greater.

2. **Concrete Base Repair**

   Full depth saw cut to the removal limits identified by the Engineer. Remove and dispose of the pavement in accordance with Section 100. Perform subgrade preparation and any removal and replacement of unsuitable material in accordance with Section 200. Replace the removed materials with type L85 concrete in accordance with Section 500. The minimum depth of pavement repair shall be nine (9) inches or equivalent to the thickness of the existing pavement plus two (2) inches, whichever is greater.
D. Surface Preparation

The method of surface preparation shall be in accordance with the Contract Documents or as directed by the Engineer.

1. Asphalt Overlay

The Contractor shall be responsible for installing a physical barrier to protect all inlets, manholes, flumes, drainage ways, or other similar structures from material entering the drainage system or structure. Such protective measures shall be removed, and the area cleaned up at the end of each day. Any material entering the system or structure during construction operations shall be cleaned up immediately and the protection restored. Failure to provide proper protection and clean up may be subject to fines and/or withholding of progress payments.

The Contractor shall develop an accurate dimensioned map identifying the location of all manholes, utility appurtenances, or other structures within the area to be paved.

Cold planing or milling shall be in accordance with the Contract Documents and Section 100. When resurfacing existing pavement and unless otherwise indicated in the Contract Documents, mill a nominal depth of one and three-fourths (1¾) inches in all areas when a wedge course or ACP leveling course is not being applied, and a nominal depth of two and one-fourth (2¼) inches when a wedge course or ACP leveling course is being applied. Unless otherwise indicated in the Contract Documents, all milled material shall be the responsibility of the Contractor to transport and dispose of in accordance with Section 100.

Before applying a tack coat, remove all dirt and loose or foreign materials from the milled surface. Apply a bituminous tack coat to all pavement surfaces and all vertical edges that will contact the ACP. It shall be the Contractor’s responsibility to clean and repair any damaged areas of over spray on the face of curbs, driveways, or other appurtenances at no additional cost to the City.

Apply a tack coat using a bituminous pressure distributor. A hand sprayer shall be used as necessary or as directed by the Engineer to provide consistent coverage of the tack coat. The application rate shall be from one-tenth to two-tenths (0.1 - 0.2) residual gallons per square yard for milled or existing surfaces. The application rate shall be from five-hundredths (0.05) to one-tenth (0.1) residual gallons per square yard for freshly laid asphaltic concrete. The roadway segment shall have a minimum coverage of ninety (90) percent on the milled surface and adjacent vertical face after the tack has cured. Segments which do not have the minimum coverage shall have an additional tack coat applied and paving operations shall not proceed until all tack has cured. Tack coat shall be applied a minimum of one (1) hour prior to ACP construction for the tacked area. Do not apply the tack coat during periods of precipitation.

Perform tack coat application in a manner that minimizes pickup or tracking of the tack coat materials. Limit the application of tack coat to no more than three (3) blocks ahead of the paving operations unless otherwise directed by the Engineer.

The tack coat shall be applied to the underlying milled or previously paved surface for each asphaltic concrete lift unless the underlying material is asphaltic concrete constructed on the same day and it has not been subjected to traffic other than asphaltic concrete construction equipment.
2. Full Depth Asphaltic Concrete Pavement

Perform subgrade preparation and any removal and replacement of unsuitable material in accordance with the Contract Documents and Section 200.

E. Weather Limitations

Before placement of the ACP, the surface shall be clean and dry. Placement of ACP during cold temperatures shall be restricted in accordance with Table 401.07. The minimum placement temperature of ACP shall be at or above the PG binder manufacturer’s recommended compaction temperature.

<table>
<thead>
<tr>
<th>Compacted Mat Thickness</th>
<th>Minimum Atmospheric Temperature, °F</th>
<th>Minimum Base Temperature, °F</th>
</tr>
</thead>
<tbody>
<tr>
<td>3&quot; or greater</td>
<td>40</td>
<td>35</td>
</tr>
<tr>
<td>1&quot; - 3&quot;</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>&lt; 1&quot;</td>
<td>50</td>
<td>45</td>
</tr>
</tbody>
</table>

F. Wedge Course or ACP Leveling Course

Thoroughly clean the existing surface and apply the tack coat and construct one (1) course of hot-mixed and hot-laid ACP having a nominal thickness of one (1) inch or less in the cleaned areas. Wedge courses or leveling courses shall be used to eliminate irregularities in the contour of existing roadways or correct minor deviations in transverse slope.

Wedge Course or ACP Leveling Course mix designs and standards shall be in accordance with Tables 401.02 and 401.03.

Leveling of any surface irregularities in conjunction with resurfacing work shall not be considered pavement repair and shall be considered as ACP Surface Course unless otherwise specified in the Contract Documents.

A wedge course or ACP leveling course of less than one (1) inch is not subject to a percentage compaction requirement but shall be compacted by uniformly rolling with asphalt compaction equipment.

G. Asphalt Placement

Schedule plant production, equipment, and delivery of material to the construction area in such a manner as to provide for a continuous operation. The Engineer must approve all haul routes over freshly placed material. Provide adequate artificial lighting during night placements.

Tandem or echelon paving shall be mandatory on all roadways classified as Arterials and Collectors or above by Federal Function Classification when adjacent lanes are available and traffic conditions allow or as directed by the Engineer. The Engineer shall provide a listing of roadway classifications upon request.

Surface and intermediate courses are defined as those lifts within the upper four (4) inches of the finished pavement surface.

The asphalt paver(s) shall spread and finish the ACP mixture in a uniform layer to the specified grade, width, and thickness. Operate the paver(s) at a speed that avoids pulling or tearing of the ACP mat and avoid stop-and-go operations. Unless otherwise directed by the Engineer,
construct the entire width of the preceding layer before any of the consecutive layers are constructed. Do not place the upper layer until the lower layer in the adjacent lane is completed. For mixes containing RAP material, the mat shall not exhibit any visual defects or cold spots from RAP conglomeration.

Match manholes, utilities, inlets, intersections, driveways, or other exposed surfaces whenever possible. The finished surface shall provide positive drainage, a smooth transition between adjoining surfaces, and a smooth ride. When multiple pavers are used, space the pavers and deliver the ACP mixture in a manner to provide a continuous hot joint along the common matching joint.

Placement of the ACP shall begin along the centerline of a crowned section or on the high side of areas with a uniform slope, unless otherwise directed by the Engineer. The minimum lift thickness for a non-leveling course shall be greater than or equal to three (3) times the nominal maximum aggregate size. Unless otherwise indicated in the Contract Documents, the minimum thickness for asphalt overlays shall be two (2) inches.

For asphalt overlays constructed atop concrete pavement, the longitudinal joint shall be located directly over the underlying concrete longitudinal joint, at the nominal lane width, or as directed by the Engineer. In the event of tapering or converging lanes, placement of the through lane shall be maintained at the designed lane width. No partial width longitudinal ACP joints will be allowed in the through lane(s).

Longitudinal joints shall be located such that traffic pavement markings (lane lines) can be installed within six (6) inches of the designed lane width without requiring installation atop the constructed longitudinal joint.

Pave intersections, driveways, or other non-mainline items upon encountering such items during mainline paving. Taper driveway ends greater than or equal to one (1) inch above the finished ACP surface with an ACP wedge constructed at a 1V:2H slope. Construction of the ACP wedge is subsidiary to items for which the Contract provides direct payment. All requirements of mainline paving apply to non-mainline ACP construction. Use the same rolling patterns as the mainline paving. Paving intersections, driveways, or other non-mainline items thirty (30) minutes or more ahead of the mainline paving will not be permitted unless otherwise directed by the Engineer.

For multiple lift full depth ACP, offset joints of underlying lifts a minimum of one (1) foot for longitudinal joints. Transverse joints shall be offset a minimum of ten (10) feet between transverse joints of successive courses.

Manually place material in small patch areas and areas inaccessible to mechanical spreading and finishing equipment.

H. **Compacting and Finishing**

Begin rolling operations before the temperature of the ACP mixture is below the required compaction temperature for the PG binder, as specified in the ACP mix design and the supplier’s recommendations. Pace the ACP paving operation to maintain compaction operations and achieve the required compaction within the recommended temperature ranges.

Operate the rollers at a slow and uniform pace. The rollers shall use scrapers or pads, and water or an asphalt release agent, to prevent adhesion of the mixture to the roller. Do not use excessive amounts of water and/or release agent.
Immediately repair any displaced or defective ACP by removing and replacing it with fresh, hot ACP mixture to the required thickness. Skin patching is unacceptable as a repair technique. Rolling operations shall continue until the Contractor achieves the required compaction, the surface is uniform in texture, and the pavement is true to grade and cross section.

Compact the ACP to the percentage of maximum theoretical density (MTD) specified. The MTD shall be determined in accordance with ASTM D2041, Standard Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures. Measure joint compaction by randomly sampling the constructed pavement located on and within three (3) inches of a construction joint.

The Contractor is responsible for monitoring compaction throughout the rolling process using a nuclear densitometer or other real-time density measuring device demonstrated to be accurate. Establish a rolling pattern that fulfills the compaction requirements defined in Tables 401.09, 401.10, 401.11, and 401.12. Perform testing in accordance with ASTM D2950, Standard Test Method for Density of Bituminous Concrete in Place by Nuclear Method, or as directed by the Engineer. The Engineer will not use the results of monitoring testing as a consideration of acceptance or rejection of the ACP constructed.

Unacceptable materials or construction shall be subject to removal and replacement or corrected to the satisfaction of the City of Omaha Public Works Department Construction Engineer prior to final acceptance of the work.

I. Crack and Joint Maintenance

Unless otherwise indicated in the Contract Documents, the Contractor shall be responsible for maintenance of all joints and any cracks developing in the ACP prior to project acceptance. All other maintenance activities shall be performed in accordance with Section 401.03 C.

Upon completion of ACP paving and manhole, inlet, or utility appurtenance adjustments, band seal the following:

- Longitudinal joints along the gutter line or abutting adjacent curb.
- Longitudinal or transverse joints abutting existing pavement.
- Longitudinal construction “cold” joints between paving lanes.
- Transverse construction headers or tie-ins.
- Random cracks readily visible from a height of four (4) feet.
- Perimeter of all manhole, inlet, and utility tie-ins and/or adjustments.

Crack and joint maintenance operations shall not commence until thirty (30) days after completion of a resurfacing segment. Additionally, crack and joint maintenance operations shall be completed within thirty (30) days after all manhole, inlet, and utility adjustments on the project are finished. If crack and joint maintenance operations begin prior to the completion of utility adjustments, additional joint maintenance will be required within thirty (30) days after finishing all utility adjustments. Crack and joint sealant installation shall be in accordance with the manufacturer’s recommendations. Sealant shall not be placed during inclement weather or when snow or surface water is present on the pavement.

401.04 Acceptance

The Engineer shall observe the work to check for compliance with the Contract Documents. Unless otherwise indicated in the Contract Documents, acceptance requirements shall be in accordance with the asphalt material properties listed in Tables 401.02 and 401.03. Perform corrective action
or removal and replacement activities at no additional cost to the City. Backfill shall be constructed to the minimum compaction requirements identified in the Contract Documents. The Engineer shall verify the compaction of the backfill in accordance with the City of Omaha Materials and Testing Manual for Public Works Construction. Concrete base shall be constructed to the minimum compressive strength requirements identified in the Contract Documents. The Engineer shall verify the compressive strength of the concrete in accordance with the City of Omaha Materials and Testing Manual for Public Works Construction.

The Engineer shall review the asphalt material test data for compliance with the required material properties, and the completed asphalt construction shall be inspected for unsealed cracks, shoving, rutting, raveling, or other surface distresses and/or defects. Corrective measures shall be performed to correct substandard test properties, observed pavement distresses, or other defects.

A. Smoothness

The maximum allowable deviation from the specified elevation is minus zero (-0), plus one-half (+½) inch, provided the deviation does not alter the designed drainage pattern. The finished surface shall be smooth and free of bumps or depressions greater than one-fourth (¼) inch in any ten (10) foot span. Repair non-conforming areas by removing enough material to allow for the construction of a lift of ACP three (3) times the nominal maximum aggregate size. Remove high spots by grinding using a diamond tipped grinding wheel or other similar equipment. Perform all repairs at no additional expense to the City.

B. Production

Acceptance shall be evaluated considering each sample area individually, as defined in Section 401.02 J.

Production tolerances, compared to asphalt pavement material property requirements listed in Tables 401.02 and 401.03, shall be in accordance with Table 401.08. All other material properties without an identified tolerance shall have no tolerance from the requirements listed in Tables 401.02 and 401.03. The Contractor shall notify the Engineer whenever a test result approaches the production tolerance.

<table>
<thead>
<tr>
<th>Test</th>
<th>Allowable Deviation from Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dust to Asphalt Ratio</td>
<td>None</td>
</tr>
<tr>
<td>Air Voids</td>
<td>None</td>
</tr>
<tr>
<td>Coarse Aggregate Angularity</td>
<td>5% below Min.</td>
</tr>
<tr>
<td>Fine Aggregate Angularity</td>
<td>0.5% below Min. for cold feed or 1.0% below Min. for ignition oven</td>
</tr>
<tr>
<td>Minimum Binder Content</td>
<td>0.0% below Min.</td>
</tr>
<tr>
<td>Asphalt Film Thickness</td>
<td>0.5 microns below Min.</td>
</tr>
</tbody>
</table>

* These tolerances are applied to the mix design specification values, not the submitted mix design targets.

The Contractor shall perform density tests under direct observation of the Engineer. The Contractor shall establish the density testing method in accordance with AASHTO T166, Standard Method of Test for Bulk Specific Gravity (Gmb) of Compacted Hot Mix Asphalt (HMA)
Using Saturated Surface-Dry Specimens; or NDOT Standard Method T587, Standard Test Methods for Density of Bituminous Concrete in Place by Nuclear Methods. When performing density tests in accordance with AASHTO T166, the Engineer will observe the Contractor obtaining, transporting, and testing the test cores. The Engineer shall take immediate possession of the test cores upon completion of the Contractor’s testing. When performing density tests in accordance with NDOT Standard Method T587, the Contractor shall use adjustment bias and/or correction factors and provide to the Engineer upon request. All correlation factors and test results shall be generated and provided to the Engineer. Any disputed test results determined using NDOT T587 will be resolved using AASHTO T166.

When performing density tests in accordance with NDOT T587, the first three (3) density locations of the project shall be cored in accordance with AASHTO T166 to calibrate the asphalt density gauge. Prior to obtaining cores, the Contractor shall calibrate the density gauge at each core location using the following steps:

1. **Calibration**
   
   A correction factor shall be established for the initial three (3) cores by calculating the difference between the average density measurement of the asphalt density gauge and the roadway core density. This correction factor shall be entered in the asphalt density gauge and used for measuring subsequent densities. The correction factor shall be verified with another core for every fifteen (15) density gauge readings that are to be recorded.

2. **Density Reading Procedure**
   
   Place the asphalt density gauge on the asphalt mat over the area to be tested. Record the density gauge reading and repeat this process for a total of five (5) readings, as detailed in Figure 401.01. An average of the five (5) readings will be used as the density reading for each location. For densities taken less than six (6) inches from the edge of the lift, density readings shall be taken as shown in Figure 401.02. The distance between density reading locations in each direction shall be no greater than twelve (12) inches.

![Figure 401.01: Asphalt density gauge reading pattern](image)
If any density test measured by the asphalt density gauge is below ninety (90) percent, a density core shall be obtained at that location and used for density testing for that sample. Density tests below ninety (90) percent shall not be used to calculate a correction factor.

The location of density tests shall be identified by a Random Sampling Schedule. When the random location is determined to be zero (0) or the lane width (i.e., twelve (12) feet on a twelve (12) foot lane), any density core shall be obtained with the outer edge of the core barrel no more than four (4) inches away (laterally) from the edge of the top of the mat for an unconfined edge, or no more than four (4) inches away (laterally) from the edge of the top of the hot mat (joint) for a confined edge. If using an asphalt density gauge at a location determined to be zero (0) or the lane width, the density test shall be obtained no more than four (4) inches away (laterally) from the edge of the mat to the edge of the density gauge base. If the initial density test at these edge-of-lane locations is less than ninety-two and one-half (92½) percent, the density test shall be adjusted up by two and one-half (2½) percent, and the resultant value shall be used in determining the density pay factor. No initial density test of ninety-two and one-half (92½) percent or greater shall be adjusted.

One (1) core for testing of joint density will be taken randomly from each calendar day’s production, as determined by the Engineer. The location of the joint density tests shall be identified by a Random Sampling Schedule. The joint density core shall be obtained no more than one (1) inch away (laterally) from the edge of the top of the mat.

The percent compaction of a density sample shall be determined by comparing the specific gravity of the density sample to the Maximum Specific Gravity (Rice) of the production sample representing the location from which the density sample was obtained.

The Contractor shall perform density testing the next working day following placement of the mixture. Three (3) density samples shall be obtained for each day’s production at locations determined by the Engineer with at least one (1) sample taken from each sample area when multiple sample areas are defined for a day’s production. Core samples shall be a minimum three (3) inches in diameter. The average density of samples for each mix type per contract defined location shall be used to compute the pay factor for density for that day’s production in each area and mix type. Density testing will not be required when the nominal layer thickness is one (1) inch or less for an individual area.

**401.05 Measurement and Payment**

The Engineer may assess pay deductions for failure to meet the acceptance requirements in accordance with Tables 401.08, 401.09, and 401.10.
Pay factors shall be applied separately to each day’s production.

Reductions in payment shall be calculated on a lump sum basis based on the unit price, tonnage and quality pay factors for each mix type per location per day’s production. The daily quality pay factor will be the average of the individual pay factors associated with the following quality testing results obtained by Contractor QC or verification testing:

- Air Voids (AV)
- Film Thickness (FT)
- Fine Aggregate Angularity of Burn-Off/Extracted Aggregate (FAA)
- Coarse Aggregate Angularity of Burn-Off/Extracted Aggregate – Two (2) Faces (CAA)
- Total Binder Content (Pb)
- Total Binder Derived for RAP (RPb)
- Mat Density (MD)
- Joint Density (JD)

**Daily Quality Pay Factor = (AV + FT + FAA + CAA + Pb + RPb + MD + JD)/8**

This factor will be calculated using quality control or verification test results for the sample area and, when multiplied by the unit price, will provide for an adjusted payment for each day’s production for each mix type for a given contract defined segment or area of Asphaltic Concrete. No Pay Factor will be used for project patching. Wedge course lifts are not considered patching and shall be measured and paid with pay factors applied as identified herein. The maximum Pay Factor for an individual day’s production shall be one-hundred (100) percent. Excess values do not extend to other production days.

The Contractor shall cease production if three (3) or more individual pay factors used to calculate the daily pay factor are below eighty (80) percent. The Contractor shall cease production if the same individual pay factor used to calculate the daily pay factor is below eighty (80) percent for three (3) or more consecutive Contractor QC or verification samples. The Contractor shall submit to the Engineer an action plan outlining changes to production or process to correct the cause of the deficiency prior to resuming production.

If the average of the daily quality pay factors for a segment or location is less than seventy-five (75) percent, the Engineer may reject some or all the asphaltic concrete constructed within the segment or location and require it to be removed and replaced at no additional cost to the City.

Determination of pay factors shall consider the average of the individual test results for each day’s production and the variability between multiple samples obtained during a day’s production. The pay factor used to calculate the daily quality pay factor for an individual test parameter shall be the lower of the pay factor identified in Tables 401.09, 401.10, 401.11, and 401.12 for the respective mix type.
### Table 401.09
Acceptance Schedule – Mix Type SPH

<table>
<thead>
<tr>
<th>Property</th>
<th>Average of Daily Tests Pay Factor*</th>
<th>Allowable Variability Between Daily Tests Pay Factor*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>100%</td>
<td>80%</td>
</tr>
<tr>
<td></td>
<td>100%</td>
<td>80%</td>
</tr>
<tr>
<td>Air Voids</td>
<td>3.0 to 5.0</td>
<td>2.0 to 2.9 or 5.1 to 6.0</td>
</tr>
<tr>
<td>Film Thickness</td>
<td>8.5 min.</td>
<td>8.00 to 8.49</td>
</tr>
<tr>
<td>Mat Density</td>
<td>92.4 min.</td>
<td>91.4 to 92.3</td>
</tr>
<tr>
<td>Joint Density</td>
<td>91.0 min.</td>
<td>90.0 to 90.9</td>
</tr>
<tr>
<td>Fine Agg. Angularity</td>
<td>44.0 min.</td>
<td>43.50 to 43.99</td>
</tr>
<tr>
<td>Coarse Agg. Angularity</td>
<td>85.0 min.</td>
<td>80.0 to 84.9</td>
</tr>
<tr>
<td>% Binder</td>
<td>5.10 min.</td>
<td>4.80 to 5.09</td>
</tr>
<tr>
<td>% Binder from RAP</td>
<td>20.00 max.</td>
<td>20.01 to 21.00</td>
</tr>
</tbody>
</table>

* Applied per mix type per contract defined segment or area per day’s production

### Table 401.10
Acceptance Schedule – Mix Type SPH Fine

<table>
<thead>
<tr>
<th>Property</th>
<th>Average of Daily Tests Pay Factor*</th>
<th>Allowable Variability Between Daily Tests Pay Factor*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>100%</td>
<td>80%</td>
</tr>
<tr>
<td></td>
<td>100%</td>
<td>80%</td>
</tr>
<tr>
<td>Air Voids</td>
<td>3.0 to 5.0</td>
<td>2.0 to 2.9 or 5.1 to 6.0</td>
</tr>
<tr>
<td>Film Thickness</td>
<td>8.5 min.</td>
<td>8.00 to 8.49</td>
</tr>
<tr>
<td>Mat Density</td>
<td>92.4 min.</td>
<td>91.4 to 92.3</td>
</tr>
<tr>
<td>Joint Density</td>
<td>91.0 min.</td>
<td>90.0 to 90.9</td>
</tr>
<tr>
<td>Fine Agg. Angularity</td>
<td>44.0 min.</td>
<td>43.50 to 43.99</td>
</tr>
<tr>
<td>Coarse Agg. Angularity</td>
<td>85.0 min.</td>
<td>80.0 to 84.9</td>
</tr>
<tr>
<td>% Binder</td>
<td>5.30 min.</td>
<td>5.00 to 5.29</td>
</tr>
<tr>
<td>% Binder from RAP</td>
<td>20.00 max.</td>
<td>20.01 to 21.00</td>
</tr>
</tbody>
</table>

* Applied per mix type per contract defined segment or area per day’s production
Table 401.11
Acceptance Schedule – Mix Type SPR

<table>
<thead>
<tr>
<th>Property</th>
<th>Average of Daily Tests Pay Factor*</th>
<th>Allowable Variability Between Daily Tests Pay Factor*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>100% 80% 60%</td>
<td>100% 80% 60%</td>
</tr>
<tr>
<td>Air Voids</td>
<td>2.0 to 4.0 1.0 to 1.9 or 4.1 to 5.0</td>
<td>1.5 max. 1.6 to 2.0 &gt;2.0</td>
</tr>
<tr>
<td>Film Thickness</td>
<td>8.5 min. 8.00 to 8.49 &lt;8.00</td>
<td>1.00 max. 1.01 to 1.20 &gt;1.20</td>
</tr>
<tr>
<td>Mat Density</td>
<td>92.4 min. 91.4 to 92.3 &lt;91.4</td>
<td>3.0 max. 3.1 to 4.0 &gt;4.0</td>
</tr>
<tr>
<td>Joint Density</td>
<td>91.0 min. 90.0 to 90.9 &lt;90.0</td>
<td>4.0 max. 4.1 to 6.0 &gt;6.0</td>
</tr>
<tr>
<td>Fine Agg. Angularity</td>
<td>42.0 min. 41.50 to 42.49 &lt;41.50</td>
<td>1.0 max. 1.1 to 1.5 &lt;1.5</td>
</tr>
<tr>
<td>Coarse Agg. Angularity</td>
<td>82.50 min. 80.00 to 82.49 &lt;80.00</td>
<td>10 max. 10.1 to 15.0 &lt;15.0</td>
</tr>
<tr>
<td>% Binder</td>
<td>5.00 min. 4.70 to 4.99 &lt;4.70</td>
<td>0.60 max. 0.61 to 1.00 &gt;1.00</td>
</tr>
<tr>
<td>% Binder from RAP</td>
<td>20.00 max. 20.01 to 21.00 &lt;21.00</td>
<td>2.00 max. 2.01 to 3.00 &gt;3.00</td>
</tr>
</tbody>
</table>

* Applied per mix type per contract defined segment or area per day’s production

In the event the Contractor disputes the pay factors for densities only, the Contractor shall be responsible to notify the Engineer and request additional testing of the densities within one (1) working day following receipt of test results for each day’s production. Only days with density pay factors less than one-hundred (100) percent are eligible for additional testing. Additional testing shall be at the cost of the Contractor. No re-rolling will be allowed in the area. Locations for additional tests will be as directed by the Engineer as identified by a Random Sampling Schedule. Density tests obtained by additional testing shall be included with original density tests to determine the density pay factors for the disputed day’s production. The Engineer may discard, re-sample, and/or replace any density test(s) determined not to be representative of the materials placed (e.g., damaged core).

Unless otherwise indicated in the Contract Documents, performance graded binder is subsidiary to items for which the Contract provides direct payment.
Unless otherwise indicated in the Contract Documents, warm mix additive is subsidiary to items for which the Contract provides direct payment.

Unless otherwise indicated in the Contract Documents, no incentive shall be provided for use of Reclaimed Asphalt Pavement (RAP), regardless of the amount utilized.

The Engineer shall measure asphalt surface courses for payment by the tons of the binder and type of asphalt surface course constructed, compacted, and accepted.

The Engineer shall measure asphalt base courses for payment by the tons of the binder and type of asphalt base course constructed, compacted, and accepted.

The Engineer shall measure asphalt wedge courses for payment by the tons of the binder and type of asphalt wedge course constructed, compacted, and accepted.

The Engineer shall measure asphalt driveways for payment by the tons of the binder and type of asphalt driveway constructed, compacted, and accepted.

The Engineer shall measure asphaltic concrete for pavement repairs for payment by the tons of the binder and type of asphaltic concrete for pavement repair constructed, compacted, and accepted. Subgrade preparation and unsuitable material replacement shall be considered incidental to asphaltic concrete for pavement repair.

Payment shall be made under the following unless otherwise indicated in the Contract Documents. The Contract Price shall be full compensation for developing the ACP mix design and QC program, anti-stripping agents/measures/techniques, surface preparation, crack and joint sealing, tack coat application, placing ACP wedge for transitions, compaction monitoring during placement operations, flag persons, barricades, warning signs, joint maintenance, and for furnishing all labor, materials, equipment, tools, and all incidentals necessary to complete the work.

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construct Asphalt Surface Course, Type ___(PG - )</td>
<td>Ton</td>
</tr>
<tr>
<td>Construct Asphalt Base Course, Type ___(PG - )</td>
<td>Ton</td>
</tr>
<tr>
<td>Construct Asphalt Wedge Course, Type ___(PG - )</td>
<td>Ton</td>
</tr>
<tr>
<td>Construct Asphalt Driveway, Type ___(PG - )</td>
<td>Ton</td>
</tr>
<tr>
<td>Construct Asphaltic Concrete for Pavement Repair, Type ___(PG - )</td>
<td>Ton</td>
</tr>
</tbody>
</table>
SECTION 500 – RIGID PAVEMENT

500  Rigid Pavement

500.01  General

A. Description

The information, submittal and material requirements, and construction requirements shall apply to all subsections within Section 500 unless otherwise specified. This section includes pavement, curb, combination curb and gutter, integral curb, sidewalk, multi-use trail, mow strip, median surfacing, and curb ramps. Stain for rigid pavement is only recommended for rehabilitation purposes.

B. Submittal Requirements

The Contractor shall submit, in accordance with the General Conditions, the following submittals:

1. Production facility certifications.
2. Portland Cement Concrete (PCC) mix design.
3. Aggregate material gradation and physical property certifications.
4. Cement material physical property certifications.
5. Admixture material certifications and manufacturer’s recommendations.
6. Reinforcement material physical property certifications.
7. Expansion joint material certifications and manufacturer’s installation recommendations.
8. Cold weather pavement construction protection methods.
9. Curing compound material certifications and manufacturer’s application recommendations.
10. Coloring agent material certifications and manufacturer’s application recommendations.
11. Joint sealing compound material certifications and manufacturer’s application recommendations.
12. Colored concrete sealing compound material certifications and manufacturer’s application recommendations.
13. Concrete stain material certifications and manufacturer’s application recommendations.
15. Pre-cast detectable warning panel sample and manufacturer’s installation recommendations.
16. Concrete delivery truck wash-out method and proposed location.
17. Penetrating concrete sealer material certifications and manufacturer recommendations.
500.02 Material Requirements

A. Portland Cement and Blended Cement for Portland Cement Concrete (PCC)

Portland cement shall conform to the requirements for Cement Type I or Cement Type II in accordance with ASTM C150, Specification for Portland Cement including Table 2 (Maximum Equivalent Alkalis requirements only) and Table 3. Blended hydraulic cements, Type IP, shall conform with Type GU Cement requirements in accordance with ASTM C595, Standard Specification for Blended Hydraulic Cements. Fly ash used for blending shall conform with Type “F” requirements in accordance with ASTM C618, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete, unless pre-approved in writing by the Engineer. Cement blending shall be performed only at the cement manufacturing facility. The maximum fly ash replacement shall be twenty-five percent (25%). Slag used for blending shall be in accordance with ASTM C989 Standard Specification for Slag Cement for Use in Concrete and Mortars. The maximum slag cement replacement shall be forty percent (40%).

All cements shall be on the Nebraska Department of Transportation (NDOT) Approved Project List (APL).

All cements shall be tested with all proposed source materials in accordance with ASTM C1567, Standard Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method). The maximum expansion allowed shall be 0.08% at fourteen (14) days and 0.10% at twenty-eight (28) days for all non-high early concrete mixes. Testing shall be performed at least annually by a third party qualified laboratory for all combinations of materials proposed for use.

B. Aggregate for PCC

Coarse aggregate shall conform to all material property requirements in accordance with ASTM C33, Specification for Concrete Aggregates, and shall conform to the gradation requirements of Table 500.01. Coarse aggregate shall consist of a minimum of seventy-five (75) percent by weight of limestone, quartzite, dolomite, or crushed gravel materials. Fine aggregate shall conform to all material property requirements in accordance with ASTM C33, Specification for Concrete Aggregates, and shall conform to the gradation requirements of Table 500.02. For Type “L” mixes, coarse aggregate shall comprise 30±3% of the total aggregate content by weight.
### Table 500.01
Coarse Aggregate for Concrete Gradation Limits

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Aggregate for Concrete L6, L65, L75, L85</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Target Value</td>
<td></td>
</tr>
<tr>
<td>1 inch</td>
<td>100</td>
<td>-8</td>
</tr>
<tr>
<td>¾ inch</td>
<td>78</td>
<td>±12</td>
</tr>
<tr>
<td>½ inch</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>⅜ inch</td>
<td>30</td>
<td>±15</td>
</tr>
<tr>
<td>No. 4</td>
<td>6</td>
<td>±6</td>
</tr>
<tr>
<td>No. 10</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>No. 20</td>
<td>2*</td>
<td>±2</td>
</tr>
<tr>
<td>No. 200</td>
<td>1.5</td>
<td>±1.5</td>
</tr>
</tbody>
</table>

*The percent passing may be increased to 3 ± 3 provided no more than 1.5% is passing the No. 200 sieve when washed.

### Table 500.02
Fine Aggregate for Concrete Gradation Limits

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Aggregate for Concrete L6, L65, L75, L86</th>
<th>Tolerance</th>
<th>Sand-Gravel Aggregate for Concrete SG65</th>
<th>Target Value</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Target Value</td>
<td>Tolerance</td>
<td>Target Value</td>
<td>Tolerance</td>
<td></td>
</tr>
<tr>
<td>1 inch</td>
<td>100</td>
<td>None</td>
<td>100</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>¾ inch</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>No. 4</td>
<td>87</td>
<td>±10</td>
<td>66</td>
<td>±22</td>
<td></td>
</tr>
<tr>
<td>No. 10</td>
<td>60</td>
<td>±10</td>
<td>37</td>
<td>±13</td>
<td></td>
</tr>
<tr>
<td>No. 30</td>
<td>28</td>
<td>±12</td>
<td>12</td>
<td>±8</td>
<td></td>
</tr>
<tr>
<td>No. 200</td>
<td>1.5</td>
<td>±1.5</td>
<td>1.5</td>
<td>±1.5</td>
<td></td>
</tr>
</tbody>
</table>

C. Water for PCC

All water used in the PCC mixture shall be potable in accordance with AASHTO T26, Quality of Water to be used in Concrete.

D. Admixtures for PCC

Admixtures shall be in accordance with ASTM C494, Standard Specification for Chemical Admixtures for Concrete; ASTM C1017 Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete; or ASTM C260, Standard Specification of Air-Entraining Admixtures for Concrete. Dosages shall be in accordance with the manufacturer’s recommendations. All admixtures used shall be compatible with all other components of the concrete mixture.

Do not use any admixtures that retard the initial set of the PCC, unless otherwise directed by the Engineer. Add water-reducing admixtures separately from air-entraining admixtures in
accordance with the manufacturer’s recommendations. The air entrainment admixture and the water-reducing admixture shall be compatible.

Calcium chloride shall be in accordance with ASTM D98, Specifications for Calcium Chloride. The maximum amount of calcium chloride added shall not exceed two (2) percent by weight of the total amount of cement in the mixture. Calcium chloride shall not be used unless otherwise directed by the Engineer. Add calcium chloride in accordance with the manufacturer’s recommendations. Mix the calcium chloride solution with the concrete for a minimum of thirty (30) revolutions before commencing placement of the PCC.

E. Coloring Agent for PCC

When indicated for use in the Contract Documents, coloring agent shall be in accordance with ASTM C979, Pigments for Integrally Colored Concrete. Dosage and application of coloring agent shall be in accordance with the manufacturer’s recommendations.

F. Preformed Expansion Joint Material

Preformed joint material for expansion joints shall be in accordance with ASTM D1751, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types). When more than one (1) piece is required for a joint, securely fasten the abutting ends by stapling or other positive fastening means. Compressible foam, and other associated materials not in accordance with ASTM D1751, shall not be used as expansion joint material when forming straight lines.

G. Joint Sealant

Joint sealant shall be a polyurethane, silicone, or bitumastic liquid material as specified in the Contract Documents, intended for use as a PCC pavement sealant, and shall be in accordance with ASTM D5893, Standard Specification for Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements; or ASTM D6690, Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements, Type II sealant. For colored PCC applications, color match the sealing compound to the colored PCC. The Engineer shall approve the color match before application begins.

H. Reinforcement for PCC

Tie bars shall be deformed steel bars in accordance with ASTM A615, Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement; or ASTM A996, Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement. Do not use Grade 50 or Grade 60 rail steel bars for tie bars bent or straightened during construction. For construction requiring bent bars, use Grade 40 tie bars in accordance with ASTM A615, Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement. Keep reinforcing metal clean and free of rust or foreign material. Protect reinforcing materials from rust due to weather until PCC placement.

All tie bars shall be epoxy coated in accordance with AASHTO M284, Standard Specification for Epoxy-Coated Reinforcing Bars: Materials and Coating Requirements.

I. Curing Materials for PCC

Curing materials shall be liquid, membrane-forming compounds, or polyethylene sheeting. Liquid membrane-forming compounds for curing PCC shall conform to the requirements for Type 1, 1-D, or 2, Class A in accordance with ASTM C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete. Polyethylene sheeting for curing PCC
shall be in accordance with ASTM C171, Standard Specification for Sheet Materials for Curing Concrete.

J. **PCC Mix Proportioning and Required Properties**

Proportion PCC mixtures to meet the requirements of Table 500.03. Manufacture the PCC in accordance with ASTM C94, Standard Specification for Ready-Mixed Concrete. Mix designs for each component combinations proposed for use shall be submitted annually prior to use of any individual mix proportioning.

<table>
<thead>
<tr>
<th>Table 500.03</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PCC Properties</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mix Type</th>
<th>L6*</th>
<th>S6G65*</th>
<th>L65</th>
<th>L75**</th>
<th>L85**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cement Content, lbs. per cu. yd.</td>
<td>564 min.</td>
<td>611 min.</td>
<td>611 min.</td>
<td>705 min.</td>
<td>799 min.</td>
</tr>
<tr>
<td>Coarse Aggregate, % of Total Aggregate**</td>
<td>30±3</td>
<td>0</td>
<td>30±3</td>
<td>30±3</td>
<td>30±3</td>
</tr>
<tr>
<td>Fine Aggregate, % of Total Aggregate**</td>
<td>70±3</td>
<td>100</td>
<td>70±3</td>
<td>70±3</td>
<td>70±3</td>
</tr>
<tr>
<td>Maximum Water Cement Ratio</td>
<td>0.45</td>
<td>0.48</td>
<td>0.42</td>
<td>0.40</td>
<td>0.38</td>
</tr>
<tr>
<td>Minimum 3-Day Compressive Strength, psi***</td>
<td>N/A</td>
<td>N/A</td>
<td>3000</td>
<td>4500</td>
<td>5000</td>
</tr>
<tr>
<td>Minimum 7-Day Compressive Strength, psi***</td>
<td>2500</td>
<td>2500</td>
<td>3500</td>
<td>4500</td>
<td>5000</td>
</tr>
<tr>
<td>Minimum 28-Day Compressive Strength, psi</td>
<td>3500</td>
<td>3500</td>
<td>4000</td>
<td>4500</td>
<td>5000</td>
</tr>
<tr>
<td>Air Content, %</td>
<td>7.0±1.0</td>
<td>7.0±1.0</td>
<td>8.0±1.0</td>
<td>8.0±1.0</td>
<td>8.0±1.0</td>
</tr>
<tr>
<td>Slump (Formed Pavement), inches</td>
<td>2.5±1.5</td>
<td>2.5±1.5</td>
<td>2.5±1.5</td>
<td>2.5±1.5</td>
<td>2.5±1.5</td>
</tr>
<tr>
<td>Slump (Slip-form Pavement), inches</td>
<td>1.5±1.5</td>
<td>1.5±1.5</td>
<td>1.5±1.5</td>
<td>1.5±1.5</td>
<td>1.5±1.5</td>
</tr>
<tr>
<td>PCC Temperature during placement, °F</td>
<td>70±20</td>
<td>70±20</td>
<td>70±20</td>
<td>70±20</td>
<td>70±20</td>
</tr>
</tbody>
</table>

*Mixes for use in sidewalks, guardrails, and pipe plugs only, or as directed in the Contract Documents or by the Engineer.

**Three or more aggregate blends may be considered for use by the Engineer. Additional aggregate mix designs with more than two (2) aggregate materials are subject to all other requirements for materials, proportioning, physical properties, and strength requirements. Proposed mix designs shall include all information required for one or two aggregate mix designs before being considered or approved.

***3-Day and 7-Day Compressive Strengths to be used for Annual Mix Qualification purposes only.

Referenced Test Procedures:

- ASTM C39, Test Method for Compressive Strength of Cylindrical Concrete Specimens
- ASTM C231, Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
- ASTM C173, Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
- ASTM C143, Test Method for Slump of Hydraulic Cement Concrete
1. Plastic PCC Material Testing
   a. Batch Time
      Any material not placed within the time requirements of Section 500.03 G shall be rejected and removed from the project site.
   b. Slump, Air Content, Temperature
      The delivered material shall be tested to check for compliance with the requirements of Table 500.03. Any material not meeting all three (3) requirements shall be rejected and removed from the project site. Material shall not be placed until the tests are completed and results determined to be acceptable. On-site addition of air entraining agent shall not be allowed unless otherwise directed by the Engineer. The Contractor shall provide written documentation of the manufacturer’s recommendations, including compatibility with the concrete component materials, prior to adding any air entraining agent on-site. Addition of air entraining agent on-site shall be in accordance with the manufacturer’s recommendations.

K. Penetrating Concrete Sealers
   Penetrating concrete sealers shall be on the Nebraska Department of Transportation (NDOT) Approved Product List (APL) for the intended application.

500.03 Construction Requirements

A. Equipment
   All equipment, tools, and machinery used in the work shall be maintained in accordance with the manufacturer’s recommendations. The Engineer reserves the right to reject the use of any equipment, tools, or machinery which is not working properly or functioning as it is intended.

1. PCC Production Facility and Delivery Fleet
   The PCC production facility and delivery fleet shall be in accordance with Section 3, Certification of Ready Mixed Concrete Production Facilities, of the National Ready Mixed Concrete Association Quality Control Manual, as certified by a licensed Professional Engineer. Maintain the production facility to comply with the requirements of such certification. The Engineer reserves the right to verify that the production facility complies with the certification requirements. Only central mixing production facilities are acceptable.

   The production facility shall provide the batch information for each load of PCC delivered to the site. At a minimum, the batch information shall include the component materials, the target batch weights and actual batch weights of component materials, free moisture content of aggregates, water cement ratio of batch, the target slump and amount of additional water added at production facility after batching. PCC delivery tickets shall be prepared as prescribed in the National Ready Mixed Concrete Association’s Quality Control Manual. A ticket with the batch information shall accompany each load to the delivery site and be available for the Engineer. Failure to provide a batch ticket with the minimum information shall result in rejection of the entire load of PCC delivered to the site.
2. **Pumping and Conveying**

Pumping equipment shall use uniformly sized pipes and hoses having a minimum diameter equal to three (3) times the maximum aggregate size. Pumping equipment shall permit PCC placement at any location within the placement area. Locate the pump equipment as near as practical to the final PCC destination. Configure pipes on pumping equipment to minimize bends or turns. Prime pumping equipment and discard materials used to prime pumping equipment before commencing PCC placement operations. Operate pumping equipment to supply PCC as continuous as possible. PCC shall conform to the requirements of the Contract Documents after pumping.

Conveyor equipment shall use belts that are concave and sized to accommodate the required weight of PCC. Conveyor equipment shall permit PCC placement at any location within the placement area. Conveyor equipment shall be capable of stopping, holding, and restarting when fully loaded. Locate the conveyor equipment as near as practical to the final PCC destination. Pre-wet conveyors before commencing PCC placement. Operate conveyor equipment to supply PCC as continuous as possible. Maintain the slope of conveyors to prevent loss or segregation of the PCC material during conveyance. PCC shall conform to the requirements of the Contract Documents after conveying.

3. **Paving Machines**

Paving machines shall be self-propelled and capable of spreading, consolidating, striking off, and shaping the necessary quantity of PCC at a minimum of twenty-four (24) feet wide. Contractors proposing to use a paver less than twenty-four (24) feet wide must have the Engineer’s written approval. Paving machines shall use a mechanical spreading device capable of distributing the material transversely, uniformly, and without segregation. Protect previously placed or adjacent pavement from paving machine tracks using cushions comprised of rubber or wood. Operate paving machines at a steady pace that conforms to the manufacturer’s recommendations and provides a finish meeting the requirements herein. Vibrators shall be internal tube vibrators. Vibrators shall operate at frequencies between four thousand (4,000) and eight thousand (8,000) vibrations per minute, and be capable of consolidating the full depth and width of the PCC without causing segregation.

4. **Consolidation and Strike-Off**

A minimum of two (2) manual tube vibrators shall be required to be maintained and available during any PCC placement operation. PCC placed at any design thickness shall be vibrated and consolidated, regardless of the screed or strike off equipment used.

Vibrating screeds shall have a minimum weight of eight (8) pounds per linear foot and a minimum vibration frequency of three thousand five hundred (3,500) revolutions per minute at any point along the screed. Screeds or any equipment capable of striking off the necessary quantity of PCC, which are not equipped with internal tube vibrators, shall use additional vibrating systems consisting of manual tube vibrators capable of consolidating the full depth and width of the PCC without causing segregation.

5. **Moveable Foot Bridges**

Moveable foot bridges shall be designed and constructed to span the width of the pavement under construction without coming in contact with the concrete.
6. **Saws**

Joint cutting saws shall be equipped with a water-cooled, diamond-tipped blade. Saws shall have an adjustable guide pointer. Keep a minimum of two (2) operational saws on-site during saw-cutting operations. Early-entry saws shall be approved by the Engineer before use on-site. At a minimum, equip early-entry saws with an anti-ravel skid plate. Replace the anti-ravel skid plate in accordance with the manufacturer’s recommendations.

7. **Penetrating Concrete Sealant Applicators**

Penetrating concrete sealant applicators shall be equipped with pressure gauges, tachometer, and distribution tables or meters. The spray bar shall be capable of applying sealer in a single pass on one (1) full lane width. When application widths are less than a single lane, nozzles shall be shut off to apply sealer to the specified width. The spray bar shall have a positive shut off device to prevent dripping after the flow is shut off. The sealant will be measured through a calibrated meter or with calibrated tanks or by scale tickets. The Contractor shall furnish documentation of meter or supply tank calibration. Hand application shall be permitted for projects having a total area less than one-thousand five-hundred (1,500) square yards, and projects with total area greater than one-thousand five-hundred (1,500) square yards shall use a mechanical application method.

8. **Joint Sealant Applicators**

Hot-applied joint sealant applicators shall consist of a double-walled melting pot with a mechanical agitator that continuously stirs the material. The heating unit shall not apply direct heat to the sealant material. Applicators shall use a pressurized system for placing the material. Applicators shall have flow controls that allow the operator to control the flow of the heated material. Use an applicator nozzle that fills the joint from the bottom to the top. Cold-applied joint sealant applicators shall conform to the manufacturer’s recommendations.

9. **Straightedge**

The Contractor shall keep on-site a minimum of one (1) ten (10) foot straightedge and one (1) master straightedge. The master straightedge shall consist of a metal-channel with minimum dimensions of six (6) inch width and ten (10) foot length. These straightedges shall be used to confirm the maximum allowable surface deviation in accordance with Section 500.03 K.

10. **Curb Inlet Throat Forms**

The Contractor shall utilize a curb inlet throat form meeting the dimensions indicated on Standard Plate No. 702-09 for the construction of inlet throats.

B. **Subgrade Preparation**

Subgrade preparation shall be in accordance with the Contract Documents and Section 200.

C. **Forms for PCC**

Straight forms shall be rigid metal. The maximum deflection of forms shall not exceed one-eighth ($\frac{1}{8}$) inch in ten (10) feet when tested as a simple beam and subjected to a center load of one thousand seven hundred (1,700) pounds. Clean and oil forms before PCC placement.

The minimum length of each form shall be ten (10) feet. The depth of each form shall be equivalent to the design thickness at the edge of the PCC. Bolt additional forms to the top of a
form as necessary to achieve additional depth. Use a minimum of three (3) anchors for each individual form.

Radius forms may be comprised of wood or metal. Wood radius forms shall be rigid and finished on the PCC side of the form. The rigidity of the radius forms shall be as needed to resist deformation under the PCC load. Anchor radius forms as necessary to maintain the shape of the radius.

Lug-outs or box-outs at inlet throats or intersection street radius tie-ins shall be constructed using forms at locations shown on the Contract Documents or as directed by the Engineer. Construct PCC header forms sized and located as indicated in the Contract Documents.

Bed and join forms neatly and tightly to line and grade in a manner that resists movement. Do not place forms on pedestals to maintain proper grade. Remove and reset forms that vary more than one-eighth (1/8) inch in ten (10) feet from line or grade.

Use the edge of existing PCC as a form as necessary, provided the existing PCC has a smooth vertical face or a keyed face that is free of soil or other contaminants.

D. Preformed Expansion Joint Material

Install preformed expansion joint material at the locations indicated in the Contract Documents or as directed by the Engineer. Place the preformed expansion joint material across the transverse length of the pavement in accordance with Standard Plate 501-01. Maintain the position of the preformed expansion joint material during PCC placement. Shape the preformed expansion joint material to match the shape of the integral curb.

E. Reinforcing Steel Tie Bars

Place reinforcing steel tie bars as indicated in the Contract Documents and in accordance with the Standard Plates. Manually place the tie bars three (3) inches from an existing longitudinal construction or expansion joint and two (2) inches from an existing transverse construction or expansion joint. Place the tie bars within one-fourth (¼) inch of the elevation required. Position the tie bars before placing the PCC. Use metal supports to maintain the position of the tie bars. Remove any loose rust or mill scale present on tie bars. Do not place any load on positioned tie bars that causes the tie bars to move out of position. Maintain the position of the tie bars before, during, and after PCC placement.

Place tie bars mechanically using equipment designed and intended for this purpose. Mechanically placed tie bars are subject to the positioning requirements for manually placed reinforcement.

F. Manhole and Utility Valves Adjustments

Manholes, utility valves, and other utility access points shall be adjusted to final PCC surface elevation before PCC placement. Manhole adjustments and external frame seals shall be in accordance with Section 700. Final adjustment of manholes and utility valves in paving machine operations is allowable after PCC placement and before hardening. Box-out forms intended to isolate manholes and utility valves from surrounding concrete shall not be used, except at inlet throats or as otherwise directed by the Engineer. Secure all embedded items, positioned before PCC placement, using supports and ties.
G. Placing PCC

Before commencing PCC placement, the Contractor shall designate an area for washing out empty delivery trucks. The designated area shall contain the run-off from washing operations and shall be in accordance with all applicable laws and ordinances.

Before commencing PCC placement, verify that all tie bars, construction joints, headers, and embedded items are properly installed and/or adjusted, and free of mud, oils, or other coatings that may affect bonding. Provide sufficient lighting for placement and finishing operations. Do not place PCC at night or in low-light conditions without prior approval of the Engineer. Moisten the face of construction joints and the prepared subgrade immediately before PCC placement. Do not walk or stand on positioned reinforcement during PCC placement. Accomplish PCC placement using buckets, hoppers, buggies, chutes, conveyor belts, and/or other placement equipment. Use clean equipment having proper capacity and in proper working order. The maximum allowable free-fall drop for PCC shall be five (5) feet.

Position equipment to allow an unrestricted vertical drop to the point of placement or into the conveyor vehicle. Accomplish PCC placement using the lowest practical slump that allows for proper consolidation. Deposit fresh PCC at or near its final position in the placement. Maintain the slope of chutes and drop chutes to facilitate continuous, controlled, and non-segregated PCC supply. Use chutes or drop chutes having a minimum diameter of nine (9) inches. Place PCC in a manner that minimizes lateral movement of the deposited material. The Contractor shall be responsible for maintaining the prepared subgrade during PCC placement operations. Where necessary, the Contractor shall place sheets of plywood or other similar material to accommodate the placing equipment and/or reduce the PCC delivery load volumes to avoid damaging the prepared subgrade. Unless otherwise directed by the Engineer, the Contractor shall prohibit concrete delivery trucks on the prepared subgrade.

PCC shall be consolidated, leveled, and finished within thirty (30) minutes of it being placed on the grade. PCC shall not be kept in non-agitating trucks (i.e., dump trucks) more than thirty (30) minutes after batching. PCC shall not be kept in agitating trucks more than ninety (90) minutes after batching.

Deliver PCC at a rate to allow uninterrupted placement operations. Place PCC in a manner that minimizes disturbance to the forms, reinforcement, and underlying materials. Place a sufficient quantity to allow for proper consolidation and strike-off to the required elevation and thickness. Handle the PCC in a manner that minimizes segregation.

Water shall not be added to the PCC without the approval of the Engineer. Do not add water to loads not accompanied by the batch information. If information regarding the amount of mixing water added at the plant is not available, do not add any water on-site. Add water to individual loads on-site before commencing discharge. Do not exceed the maximum allowable water-cement ratio. Mix PCC for a minimum of thirty (30) revolutions after adding water on-site. Do not add any water after commencing PCC discharge.

Admixtures shall be added to the PCC at the plant. Do not add any admixtures on-site without the approval of the Engineer. Admixtures shall be added to the PCC in accordance with the manufacturer’s recommendations.

After placing and before striking off, consolidate PCC using internal vibration or manual tube vibrators. Use internal vibrators in accordance with the manufacturer’s recommendations. Insert vertically and immediately remove manual tube vibrators at regular intervals less than three (3) feet apart. Do not drag manual tube vibrators laterally through the PCC. Allow
operating vibrators to sink into the PCC under their own weight. Do not force vibrators into semi-hardened PCC. Vibrating screeds do not provide adequate consolidation. Use of a manual tube vibrator shall be required when using a vibrating screed.

At the completion of the placement or if the placement is interrupted by more than thirty (30) minutes, place a transverse construction joint extending the full width and depth of the placement. Locate transverse construction joints in the placed PCC at the location of the closest joint indicated in the Contract Documents.

For colored PCC applications and imprinted applications, prepare a complete test sample of the PCC for approval by the Engineer before commencing construction of the colored or imprinted PCC. The cost to provide and remove a test sample shall be incidental to other items for which direct payment is made.

H. Evaporation Rate and Temperature Requirements

1. Evaporation Rate

PCC is sensitive to ambient air temperature, humidity, and wind. For evaporation rates greater than fifteen-hundredth pounds per square feet per hour (0.15 lbs/ft²/hr), take precautions against shrinkage cracking. For evaporation rates greater than two-tenth pounds per square feet per hour (0.2 lbs/ft²/hr), cease PCC placement. The Contractor shall determine, and verify with the Engineer, the evaporation rate in accordance with the following equation:

\[
E = (T_c^{2.5} - rT_a^{2.5})(1 + 0.4V) \times 10^{-6}
\]

Where:
- \( E \) = evaporation rate, lb/ft²/hr;
- \( T_c \) = concrete temperature, °F;
- \( T_a \) = air temperature, °F;
- \( r \) = relative humidity in percent/100; and
- \( V \) = wind velocity, mph.

2. Hot Weather PCC Construction

When the ambient air temperature is between seventy-five (75) degrees Fahrenheit and one hundred (100) degrees Fahrenheit, the maximum allowable temperature for the PCC mixture being placed shall be ninety (90) degrees Fahrenheit. The Contractor shall take necessary steps to control the temperature of the PCC mix to ensure delivery and placement of the PCC at a maximum mix temperature of ninety (90) degrees Fahrenheit or below.

Do not commence PCC placement when the ambient air temperature reaches or exceeds ninety (90) degrees Fahrenheit. If PCC placement has begun and the ambient air temperature reaches or exceeds ninety (90) degrees Fahrenheit or above during PCC placement, the curing compound shall be applied immediately after finishing the PCC in accordance with Section 500.03 H. If PCC placement has begun and the ambient air temperature reaches one hundred (100) degrees Fahrenheit or above, cease work.

---

3. Cold Weather PCC Construction

Cold Weather PCC Construction requirements shall be met when the ambient air temperature falls to or is expected to fall below forty (40) degrees Fahrenheit during the three-day (3-day) protection period.

Do not place PCC on frozen materials, and all surfaces contacting the PCC shall be at or above thirty-two (32) degrees Fahrenheit, including any reinforcing steel tie bars. Do not commence PCC placement until the ambient air temperature is thirty-five (35) degrees Fahrenheit and rising. If PCC placement has begun and the ambient air temperature falls below thirty-five (35) degrees Fahrenheit, cease placement operations. Do not place PCC below the minimum allowable air temperature without prior authorization by the Engineer. PCC placement shall include all necessary measures to maintain the surface temperature of the PCC at or above fifty (50) degrees Fahrenheit for a minimum of three (3) days. The cost of providing insulated blankets or other approved means to maintain the PCC surface temperature at or above fifty (50) degrees Fahrenheit shall be considered subsidiary to items for which direct payment is made. The Contractor shall assume all risk associated with the placing of PCC during cold weather, and permission given by the Engineer to place PCC during such time will in no way relieve the Contractor of the responsibility for satisfactory results.

If at any time during the initial three (3) day curing period the PCC surface temperature drops below the required minimum temperature, then the Contractor shall be responsible for all testing required by the Engineer to verify no damage was caused to the PCC due to temperature conditions.

If at any time during the initial three (3) day curing period the surface temperature of the PCC drops below freezing, then the PCC shall be removed and reconstructed at no additional cost to the City.

Suggested methods of protecting the PCC from cold temperatures include one (1) to four (4) layers of burlap, one (1) to four (4) layers of plastic sheeting interspersed with burlap, insulated thermal blankets, or some combination of these materials all secured in place.

Internal temperature testing may be allowed by the Engineer, provided the Contractor has submitted and received acceptance of a verifiable surface temperature measurement method that includes a correlation between internal temperature measurement equipment and surface temperature.

The Engineer reserves the right to accept, reject or deduct from payment, any placed PCC if it fails to meet the requirements of hot or cold weather PCC construction.

I. Finishing, Curing, and Protecting PCC Pavement

Strike off and finish the PCC to the elevation specified in the Contract Documents. Use a slip-form paver to strike off and finish the PCC. Contractors proposing to use methods other than a self-propelled slip-form paver, including a rail-guided finishing machine, vibrating metal screed, or other equipment, must have the Engineer’s written approval. Hand finish as necessary.

Remove material build-up from the forms before strike off or finishing begins. Operate the finishing equipment at a uniform speed in accordance with the manufacturer’s recommendations. Adjust the speed of the finishing equipment if surface distressing occurs.

A ten (10) foot straightedge shall be used to check the surface for any irregularities. Checks shall be made parallel to the center line of pavement at all locations where mechanical equipment
starts and stops, periodically during extended paving operations, and in all directions of hand pours. Finish the edges of the PCC surface using appropriate edging tools. Correct any irregularities in the surface and re-finish.

Minimize screeding, floating, and troweling operations to avoid overworking or over-manipulating the PCC. Remove any free water present on the PCC surface between finishing operations. Do not use cement or sand-cement mixtures to remove free water. Do not use finishing tools on PCC having free water present on the surface.

An evaporation retardant may be used to aid in the finishing of the surface as necessary. Water added to the surface shall not be allowed.

Upon completion of the finishing operation, texture the PCC surface by a wet, double-burlap drag or light broom. Drag the burlap parallel to the placement direction. Lightly broom the surface uniformly and perpendicular to the placement direction. Mist water on the burlap to maintain adequate moisture in the burlap. Do not pressure spray or otherwise apply excessive amounts of water onto any burlap that is atop fresh PCC. Replace the burlap or broom if they mar the PCC surface.

For driveway and sidewalk paving, imprint the name of the Contractor and the year of construction into the unhardened PCC surface using a pre-fabricated stamp. Use block letters between one (1) and two (2) inches in height. The depth of the imprint shall be three-eighth (3/8) to one-half (½) inches. Imprint every one-hundred (100) linear feet or as directed by the Engineer.

For imprint applications, apply the imprint form after the finishing operation and while the PCC surface is in a plastic state. Apply the imprint forms perpendicular to the PCC edge or centerline.

Within one (1) hour of PCC placement, protect all exposed, finished PCC surfaces. Use protection measures that inhibit moisture loss. Apply liquid membrane-forming curing compounds at the concentration and application rate recommended by the manufacturer. Do not use liquid membrane-forming curing compounds for PCC base that will receive an asphalt concrete pavement (ACP) surface. For colored PCC applications, apply liquid sealer in accordance with the manufacturer’s recommendations.

The application rate of water based dissipating curing compound and liquid membrane-forming curing compound shall be a minimum of one (1) gallon per two-hundred (200) square feet of surface area when using a mechanical application method, or a minimum of one (1) gallon per one-hundred (100) square feet of surface area when using a hand sprayer application method. With formed paving, the sides of the pavement slab shall be covered with the curing compound within thirty (30) minutes after removal of the forms. With slip-formed paving, the sides of the pavement slab shall be covered with the curing compound within one (1) hour of PCC placement.

The Contractor shall be responsible for protecting freshly placed PCC pavement from damage to the finished surface, which includes, but shall not be limited to, damage resulting from weather, human, or construction activity. Any repairs to unhardened PCC pavement shall be completed promptly before the PCC has hardened. The Contractor will be required to have available, at all times, materials for the proper protection of the edges and the surface of unhardened PCC pavement. Such protective materials shall have a nominal width not less than the width of the pavement plus sufficient width to cover the edges and curbs. The protective materials shall be either burlap or plastic film material suitable for the protection of the surface of the pavement.
J. Pavement Joints

Pavement joints shall be constructed in accordance with the Contract Documents and Standard Plate 501-01. Saw longitudinal and transverse pavement joints using a wet saw equipped with a diamond-tipped blade. Sawing shall begin as soon as the pavement has sufficiently hardened to allow sawing without tearing or raveling. Once the sawing operation begins, the Contractor shall continue sawing until all joints have been completed. Use a straight, chalked line or other reference for guiding the line of the saw. Continue all saw-cuts through any new gutter, combination curb and gutter, or integral curb attached to the pavement. Sequence the sawing to prevent random cracking.

Do not use early-entry saws without prior approval by the Engineer. Early entry saws shall cut a minimum of one-sixth \( \frac{1}{6} \) of the depth of the PCC, but not less than one (1) inch for any PCC thickness.

K. Penetrating Concrete Sealer

Penetrating Concrete Sealer shall only be used on arterial street projects and major collector streets. Penetrating Concrete Sealer shall not be required within Sanitary and Improvement Districts (SIDs) or local streets unless otherwise indicated in the Contract Documents. Application of Penetrating Concrete Sealer shall generally occur one to three years after construction of the pavement.

Apply the concrete surface sealer a minimum of six (6) inches wide on each side of each joint or crack after a minimum of twenty-eight (28) days after placement or as recommended by the manufacturer for the intended application. After the penetrating concrete sealer is installed, the standard pavement joint sealer shall be applied unless otherwise indicated in the Contract Documents. Concrete surfaces shall be water blasted to remove curing compound. Water blasting shall not be completed until after a minimum of twenty-one (21) days after placement or as recommended by the manufacturer for the intended application. Concrete surfaces shall be cleaned with a mechanical broom then blown clean with compressed air, and any surfaces that become contaminated before the sealer is applied shall be re-cleaned. A moisture evaporation test and application control strip shall be conducted prior to demonstrate effectiveness of Contractor application method(s) prior to application of sealer on the project.

Penetrating concrete sealer shall be applied at the rate determined during the control strip demonstration. Ambient weather and concrete surface temperatures shall be in accordance with the manufacturer’s recommendations during the application process. Sealer shall be applied with sufficient drying time prior to opening to traffic.

L. Pavement Joint Sealing

Apply joint sealing compound to all pavement joints within twenty-four (24) hours of the pavement reaching three-thousand (3,000) pounds per square inch (psi) compressive strength. Clean all pavement joints immediately before sealing operations. Joints not sealed within twenty-four (24) hours after reaching three-thousand (3,000) pounds per square inch (psi) compressive strength shall be re-sawed and cleaned prior to applying joint sealing compound. Apply joint sealing compound in the pavement joints in accordance with Standard Plate 501-01. Once the sealing operation begins, the Contractor shall continue sealing until all joints have been completed. For small areas of pavement of sixty (60) square yards or less, joint sealant may be either cold-applied or hot applied material. For larger areas of pavement greater than sixty (60) square yards, hot applied material shall be used for sealing.
M. Post-Pavement Sewer Cleaning

Upon completion of all new roadway paving projects the Contractor shall clean all sanitary sewer pipes eight (8) inches and larger within the limits of paving. The sanitary sewer shall be cleaned utilizing a sewer jet, and any accumulated material shall be removed and disposed of in accordance with Section 100.

N. Defective or Substandard Rigid Pavement

Remove defective or substandard pavement to the nearest joint in accordance with Section 1000, and at no additional cost to the Owner. The Contractor is responsible for any damage or defects in the pavement as a result of, but shall not be limited to, weather conditions, human or construction activities. Remove and replace, in accordance with Section 1000, any areas of the pavement that contain random cracking, plastic shrinkage cracking, scaling, high spots, depressions, other defects, or substandard conditions as determined by the Engineer.

The maximum allowable deviation from plane is one-fourth (¼) inch in any ten (10) foot span. The maximum allowable deviation from the specified elevation is minus zero (-0) to plus one-half (+½) inch provided the deviation does not alter the designed drainage pattern. The maximum allowable deviation from horizontal alignment is one (1) inch. The maximum allowable deviation from horizontal alignment at tie-in locations is one-half (½) inch.

Correct surface deviations by removing and replacing the non-complying section of pavement. At the sole discretion of the Engineer, correct surface deviations by grinding the pavement using a diamond-tipped grinding wheel in accordance with Section 100. Do not grind the pavement if the pavement will not meet elevation or thickness requirements after grinding. In areas where surface deviations are corrected by diamond grinding, the Contractor shall re-saw and re-seal all pavement joints.

At the sole discretion of the Engineer, single cracks less than one-eighth (⅛) inch in width, and within only a single panel of pavement, shall be repaired by routing and sealing. The Contractor shall rout random cracks to a minimum depth of one (1) inch and a maximum width of three-eighth (⅜) inch. Cracks within a single panel greater than one-eighth (⅛) inch in width shall be removed and replaced in accordance with Section 1000. For multiple cracks within a single panel, or a single crack continuous through multiple panels, the entirety of any affected panel(s) shall be removed and replaced at the Contractor’s expense.

Seal routed cracks within twenty-four (24) hours of routing. Clean the routed cracks immediately before sealing operations. Place joint sealant in the routed cracks to one-fourth (¼) inch below the pavement surface. Routed cracks not sealed within twenty-four (24) hours shall be re-routed and cleaned prior to installing sealant. Concrete-colored urethane-based caulk shall be used where directed by the Engineer. The Contractor shall be responsible for the cost of this repair work.

O. Opening Pavement for Use

Pavement shall not be opened to traffic until the following conditions have been fulfilled:

1. The pavement shall have reached a minimum compressive strength of three thousand (3,000) pounds per square inch (psi).
2. All pavement joints shall be sealed.
3. Backfilling of pavement and behind curbs shall be completed.
Determine the compressive strength in accordance with ASTM C39, Test Method for Compressive Strength of Cylindrical Concrete Specimens. At the discretion of the Engineer, the compressive strength used for opening the pavement may be determined in accordance with ASTM C1074, Standard Practice for Estimating Concrete Strength by the Maturity Method, as modified by the City of Omaha Materials Testing Manual for Public Works Construction. Backfill operations shall be in accordance with Section 200.
501 PCC Pavement

501.01 General

A. Description

This work includes construction of Portland Cement Concrete (PCC) pavement, PCC overlay, PCC base course, PCC driveway, or PCC header constructed on prepared subgrade, base, or sub-base materials in accordance with the specifications, lines, grades, and cross sections indicated in the Contract Documents or as directed by the Engineer.

B. Submittal Requirements

Refer to Section 500.01 B for submittal requirements.

501.02 Material Requirements

A. General

Refer to Section 500.02 for general material requirements.

501.03 Construction Requirements

A. General

Refer to Section 500.03 for general construction requirements.

501.04 Acceptance

The Engineer shall observe the work to check for compliance with the Contract Documents. Perform corrective action or removal and replacement activities at no additional cost to the City. Backfill shall be constructed to the minimum compaction requirements identified in the Contract Documents. The Engineer shall verify the compaction of the backfill in accordance with the City of Omaha Materials and Testing Manual for Public Works Construction.

A. Compressive Strength

Pavement shall be constructed to the minimum compressive strength requirements identified in the Contract Documents. The Engineer shall verify the compressive strength of the pavement in accordance with the City of Omaha Materials and Testing Manual for Public Works Construction. Any individual twenty-eight (28) day compressive strength test result more than five-hundred (500) pounds per square inch (psi) below the required compressive strength shall be evaluated by the Engineer in accordance with Table 501.01.

B. Thickness

Pavement shall be constructed to the minimum thickness shown in the plans. The Engineer shall verify the thickness of the pavement by obtaining cores in accordance with ASTM C42, Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete, and measuring in accordance with ASTM C174, Standard Test Method for Measuring the Thickness of Concrete Elements Using Drilled Concrete Cores. Determination of thickness and corrective measures relative to deficient thickness shall be as specified herein.

Cores shall be taken in accordance with the City of Omaha Materials and Testing Manual for Public Works Construction, or as directed by the Engineer. The paved area shall be divided into units. Units will be considered separately and are defined as a length of four-hundred forty (440) linear feet per driving lane. A driving lane is typically twelve (12) to thirteen (13) feet in width. For continuous pavement construction, the last unit under consideration shall be four-hundred
forty (440) feet plus any fractional part of four-hundred forty (440) feet remaining. For non-
continuous pavement construction, a unit less than four-hundred forty (440) feet shall be the
actual length of the unit.

At least one (1) core shall be taken from within each unit of the pavement at random locations
to be selected by the Engineer. Special cores may also be taken at any location where the
Engineer thinks deficiencies in materials or work quality may exist. Exploratory cores for
determining the limits of deficiencies of more than one-half (½) inch and special cores will not
be used in determining average thickness, but if deficient it shall be corrected as specified
herein:

1. **Thickness Deficiency Not More Than One-Fourth (¼) Inch**
   
   If the unit or special core taken is deficient by not more one-fourth (¼) inch from plan
   thickness, full payment will be made and no additional cores will be required in that unit.

2. **Thickness Deficiency More Than One-Fourth (¼) Inch But Not More Than One-Half (½)
   Inch**
   
   If the unit or special core is deficient by more than one-fourth (¼) inch but not more than
   one-half (½) inch from plan thickness, two (2) additional cores will be taken within the
   same unit at random locations. The average thickness of the three (3) cores will then be
   calculated. If the average thickness of these three (3) cores is deficient by not more than
   one-fourth (¼) inch, full payment will be made. If the average thickness of the cores is
deficient by more than one-fourth (¼) inch but not more than one-half (½) inch, an
   adjusted unit price will be paid in accordance with Table 501.02. If either additional core is
deficient by more than one-half (½) inch, the procedure described in Section 501.04 B.3
   will be completed before the average thickness of the pavement unit is calculated.

3. **Thickness Deficiency More Than One-Half (½) Inch**
   
   When the measurement of any core is deficient by more than one-half (½) inch from plan
   thickness, the method to establish the limits of the one-half (½) inch deficient section will
   be determined by taking exploratory cores in the following manner:

   Exploratory cores will be taken five (5) feet on either side of the deficient core’s location
   on a line parallel to the centerline of the pavement. If both exploratory cores are not more
   than one-half (½) inch deficient, no additional exploratory cores will be taken and the limits
   of deficiency more than one-half (½) inch will be between the exploratory cores.

   a. If either or both of these exploratory cores are more than one-half (½) inch deficient,
      additional exploratory cores will be taken on either side or both sides of the original
deficient core on a line parallel to the centerline of the pavement. These additional
      exploratory cores will be taken twenty-five (25) feet from the original core, and then
      consecutive cores will be cut at fifty (50) foot intervals until a thickness not more than
      one-half (½) inch deficient is found in each direction.

   b. After an additional exploratory core not more than one-half (½) inch deficient has
      been found in each direction of the original deficient core, the procedure to
determine the limits of deficiency more than one-half (½) inch will be to take an
      exploratory core halfway between the exploratory core not more than one-half (½)
      inch deficient and the nearest exploratory core more than one-half (½) inch deficient.
      This procedure will be repeated until the location (within five (5) feet) at which the
      pavement is not more than one-half (½) inch deficient is determined. After the limits
of deficiency are determined, the pavement deficient by more than one-half (½) inch shall be removed and replaced at no additional cost to the City, and in accordance with Section 1000. At the discretion of the Engineer, payment may be made as defined in Table 501.02 for areas of deficiency more than one-half (½) inch instead of removal and replacement.

c. If pavement with thickness deficiency more than one-half (½) inch is removed and replaced, payment for the entire pavement unit, including the area removed and replaced, will be made at the pay factor adjustment as determined below. At the discretion of the Engineer, if such pavement is left in place, only the portion of pavement with deficiency more than one-half (½) inch will be paid in accordance with Table 501.02, and the remaining area of the unit will have a pay factor adjustment as determined below.

(i) The two (2) outer-most exploratory cores will be used, along with a third core randomly taken from the remaining area of the unit. These three (3) cores will be used to calculate an average thickness and the corresponding pay factor will be applied in accordance with Table 501.02. When calculating the average thickness, test results greater than design thickness shall be considered to be design thickness.

The cost of exploratory cores to determine the area of deficient thickness, and additional cores to determine pay factor adjustments, shall be deducted from final payment to the Contractor.

Hand pours and small pavement areas shall have cores taken at the discretion of the Engineer. If a core taken in a hand pour or small area is deficient, the pay factor will be applied only at that location. Additional cores in hand pours or small areas will be taken, at the discretion of the Engineer, if a deficient core is found in such an area. If a deficient core is taken in a hand pour or small area, the Contractor may, at their own cost, have an additional core taken and submitted to the Engineer for evaluation.

C. Pavement Smoothness and Cracks

Refer to Section 500.03 N for pavement smoothness and crack tolerances. Pavement shall be repaired in accordance with Section 500.03 N for final acceptance.

501.05 Measurement and Payment

The Engineer may assess pay deductions for failure to meet the acceptance requirements in accordance with Tables 501.01 and 501.02.

Pay factors shall be applied separately. The pay factor for strength applies to the entire quantity of each PCC mix type. The pay factor for thickness applies to only the area of the unit as described in Section 501.04 B. Pay factors shall be deducted from final payment.

Determination of compressive strength pay factors for each type of PCC mix used shall be the average of all twenty-eight (28) day compressive strength test results for that type of PCC. When calculating the average compressive strength of each PCC mix type constructed, test results greater than design compressive strength shall be considered to be design compressive strength. The pay factor for the entire quantity of each PCC mix type shall be defined in Table 501.01.
In the event the Contractor disputes the pay factor calculation, the Contractor shall be responsible to notify the Engineer and request additional testing of the pavement. Additional testing shall be at the cost of the Contractor, and may include additional cores or other testing methods. Results of such additional testing shall be performed by an independent party, in accordance with ASTM C42, Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete, and submitted to the Engineer for further evaluation.

**Table 501.01**

PCC Pay Factor Determination

<table>
<thead>
<tr>
<th>Measured Property</th>
<th>(Average) Measured Value, psi</th>
<th>Pay Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deviation from Minimum 28-day Compressive Strength, psi</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 to -250</td>
<td></td>
<td>1.00</td>
</tr>
<tr>
<td>-250 to -500</td>
<td></td>
<td>0.85</td>
</tr>
<tr>
<td>&lt; -501</td>
<td></td>
<td>Remove and Replace*,**</td>
</tr>
</tbody>
</table>

*Individual 28 day compressive strength tests evaluated by the Engineer and accepted shall be paid at fifty (50) percent of the unit price for the representative quantity of pavement.

**Individual 28 day compressive strength tests evaluated by the Engineer and accepted shall be excluded from overall Pay Factor calculations.

**Table 501.02**

PCC Pay Factor Determination

<table>
<thead>
<tr>
<th>Measured Property</th>
<th>(Average) Measured Value, inches</th>
<th>Pay Factor**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deficiency from Design Thickness*, inches</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.0 to 0.25</td>
<td></td>
<td>1.00</td>
</tr>
<tr>
<td>0.26 to 0.50</td>
<td></td>
<td>0.80</td>
</tr>
<tr>
<td>&gt; 0.50</td>
<td></td>
<td>Remove and Replace</td>
</tr>
</tbody>
</table>

*For concrete overlay projects, omit this individual Pay Factor unless otherwise indicated in the Contract Documents.

**No additional compensation will be made to the Contractor for pavement thicknesses more than design or plan thickness.

The Engineer shall measure PCC pavements for payment by the square yards of the type and thickness of pavement constructed, backfilled, and accepted.

The Engineer shall measure PCC bases for payment by the square yards of the type and thickness of base constructed and accepted.

The Engineer shall measure PCC driveways for payment by the square yards of the type and thickness of driveway constructed, backfilled, and accepted.

The Engineer shall measure PCC headers for payment by the linear feet of header constructed, backfilled, and accepted.

The Engineer shall measure utility valve adjustments to grade for payment by each utility valve adjusted and accepted.

The Engineer shall measure utility manhole adjustments to grade for payment by each utility manhole adjusted and accepted.
The Engineer shall measure penetrating concrete sealer applications for payment by the linear feet of penetrating concrete sealer applied and accepted.

The Engineer shall measure penetrating concrete sealer applications for payment by the square yards of penetrating concrete sealer applied and accepted.

Payment shall be made under the following unless otherwise indicated in the Contract Documents. The Contract Price shall be full compensation for forming, placing PCC, backfilling, and for furnishing all labor, materials, forms, joint material, reinforcement, equipment, tools, and all incidentals necessary to complete the work.

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construct ___-inch Concrete Pavement (Type _____)</td>
<td>Square Yard</td>
</tr>
<tr>
<td>Construct ___-inch Concrete Base (Type _____)</td>
<td>Square Yard</td>
</tr>
<tr>
<td>Construct ___-inch Concrete Driveway (Type _____)</td>
<td>Square Yard</td>
</tr>
<tr>
<td>Construct Concrete Header</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Adjust Utility Valve to Grade</td>
<td>Each</td>
</tr>
<tr>
<td>Adjust Utility Manhole to Grade</td>
<td>Each</td>
</tr>
<tr>
<td>Apply Penetrating Concrete Sealer</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Apply Penetrating Concrete Sealer</td>
<td>Square Yard</td>
</tr>
</tbody>
</table>
502 Vertical Curb, Combination Curb and Gutter, and Integral Curb

502.01 General
   A. Description
      This work includes construction of vertical curb, combination curb and gutter, and integral curb constructed on prepared subgrade, base, or subbase in accordance with the specifications, lines, grades, and cross sections indicated in the Contract Document or as directed by the Engineer.
   B. Submittal Requirements
      Refer to Section 500.01 B for submittal requirements.

502.02 Material Requirements
   A. General
      Refer to Section 500.02 for general material requirements.

502.03 Construction Requirements
   A. General
      Refer to Section 500.03 for general construction requirements, in addition to the following requirements. Construct all curb and gutter in accordance with the Contract Documents, Section 500.03, and the Standard Plates. Slip-form curb and gutter paving machines shall be self-propelled, capable of spreading and striking off the necessary quantity of PCC, and contain internal vibrators. Slip-form curb and gutter paving machines shall use a mechanical spreading device that distributes the material uniformly and without segregation. The Contractor shall protect all adjacent structures or pavement from curb and gutter machine tracks using cushions comprised of rubber or wood. Finishing, curing, and protection requirements shall be in accordance with Section 500.03 H.
   B. Integral Curb
      Integral curb shall be constructed simultaneously with pavement construction, and in accordance with the details and requirements shown on Standard Plate 502-01.

502.04 Acceptance
   The Engineer shall observe the work to check for compliance with the Contract Documents. Perform corrective action or removal and replacement activities at no additional cost to the City. Curbs and gutters shall be constructed to the minimum compressive strength requirements identified in the Contract Documents. The Engineer shall verify the compressive strength of the concrete in accordance with the City of Omaha Materials and Testing Manual for Public Works Construction. Refer to Section 500.03 K for pavement smoothness and crack tolerances. Pavement shall be repaired in accordance with Section 500.03 K for final acceptance. Refer to Section 501 for compressive strength requirements and pay factor calculations. Backfill shall be constructed to the minimum compaction requirements identified in the Contract Documents. The Engineer shall verify the compaction of the backfill in accordance with the City of Omaha Materials and Testing Manual for Public Works Construction.
502.05 Measurement and Payment

The Engineer may assess pay deductions for failure to meet the acceptance requirements in accordance with Table 501.01.

The pay factor for strength applies to the entire quantity of each PCC mix type. Pay factors shall be deducted from final payment.

Perform any corrective action or removal and replacement activities at no additional cost to the City.

Integral curb construction shall be incidental to pavement construction and will not be measured and paid separately.

The Engineer shall measure vertical curbs for payment by the linear feet of vertical curb constructed, backfilled, and accepted.

The Engineer shall measure combination curbs and gutters for payment by the linear feet of the thickness of combination curb and gutter constructed, backfilled, and accepted.

Payment shall be made under the following unless otherwise indicated in the Contract Documents. The Contract Price shall be full compensation for grading, preparing subgrade, forming, placing PCC, backfilling, and for furnishing all labor, materials, equipment, tools, and all incidentals necessary to complete the work.

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construct Vertical Curb</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Construct ___” Combination Curb and Gutter</td>
<td>Linear Foot</td>
</tr>
</tbody>
</table>
503 PCC Sidewalk, PCC Multi-Use Trail, Mow Strip, and Median Surfacing

503.01 General
A. Description
This work includes construction of PCC sidewalk, PCC multi-use trail, mow strip, median surfacing, or imprinted surfacing constructed on prepared subgrade, base, or sub-base in accordance with the specifications, lines, grades, and cross sections indicated in the Contract Documents or as directed by the Engineer.

B. Submittal Requirements
Refer to Section 500.01 B for submittal requirements.

503.02 Material Requirements
A. General
Refer to Section 500.02 for general material requirements.

503.03 Construction Requirements
A. General
Refer to Section 500.03 for general construction requirements, in addition to the following requirements. Construct all sidewalk, multi-use trail, mow strip, and median surfacing in accordance with the Contract Documents, Section 500.03, and the Standard Plates. Slip-form sidewalk and multi-use trail paving machines shall be self-propelled, capable of spreading and striking off the necessary quantity of PCC, and contain internal vibrators. Slip-form sidewalk and multi-use trail paving machines shall use a mechanical spreading device that distributes the material uniformly and without segregation. The Contractor shall protect all adjacent structures or pavement from sidewalk and multi-use trail paving machine tracks using cushions comprised of rubber or wood. Finishing, curing, and protection requirements shall be in accordance with Section 500.03 I.

B. Imprinted Surfacing
Forms for imprinting concrete shall be rigid metal, plastic, or rubber, and textured with the design indicated in the Contract Documents.

Apply the forms for imprinting concrete after the finishing operation and while the PCC surface is in a plastic stage. Apply the forms for imprinting concrete perpendicular to the PCC edge or centerline, or as directed by the Engineer. Apply the forms for imprinting concrete and other associated materials or equipment in accordance with the manufacturer’s recommendations.

C. Sidewalk Curb Wall
Sidewalk curb wall shall be constructed in accordance with the Contract Documents and Standard Plate 503-03.

503.04 Acceptance
The Engineer shall observe the work to check for compliance with the Contract Documents. Perform corrective action or removal and replacement activities at no additional cost to the City. Sidewalks, multi-use trails, mow strips, and median surfacing shall be constructed to the minimum compressive strength requirements identified in the Contract Documents. The Engineer shall verify the compressive strength of the concrete in accordance with the City of Omaha Materials and Testing Standards.
Manual for Public Works Construction. Refer to Section 500.03 K for pavement smoothness and crack tolerances. Pavement shall be repaired in accordance with Section 500.03 K for final acceptance. Refer to Section 501 for compressive strength requirements and pay factor calculations. Backfill shall be constructed to the minimum compaction requirements identified in the Contract Documents. The Engineer shall verify the compaction of the backfill in accordance with the City of Omaha Materials and Testing Manual for Public Works Construction.

503.05 Measurement and Payment

The Engineer may assess pay deductions for failure to meet the acceptance requirements in accordance with Table 501.02.

The pay factor for strength applies to the entire quantity of each PCC mix type. Pay factors shall be deducted from final payment.

Perform any corrective action or removal and replacement activities at no additional cost to the City.

The Engineer shall measure PCC sidewalks for payment by the square feet of the thickness of sidewalk constructed, backfilled, and accepted.

The Engineer shall measure sidewalk curb walls for payment by the square feet of sidewalk curb wall constructed, backfilled, and accepted. Measurement of sidewalk curb walls shall be from top of curb wall to top of sidewalk along the exposed face of curb wall.

The Engineer shall measure imprinted PCC surfaces for payment by the square feet of the thickness of imprinted surface constructed, backfilled, and accepted.

The Engineer shall measure PCC median surfacing for payment by the square feet of median surface constructed, backfilled, and accepted.

The Engineer shall measure PCC mow strips for payment by the square feet of mow strip constructed, backfilled, and accepted.

The Engineer shall measure PCC multi-use trails for payment by the square feet of the thickness of multi-use trail constructed, backfilled, and accepted.

Payment shall be made under the following unless otherwise indicated in the Contract Documents. The Contract Price shall be full compensation for grading, preparing subgrade, forming, placing PCC, backfilling, and for furnishing all labor, materials, forms, joint material, reinforcement, equipment, tools, and all incidentals necessary to complete the work.

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construct ___” PCC Sidewalk</td>
<td>Square Foot</td>
</tr>
<tr>
<td>Construct Sidewalk Curb Wall</td>
<td>Square Foot</td>
</tr>
<tr>
<td>Construct ___” Imprinted PCC Surface</td>
<td>Square Foot</td>
</tr>
<tr>
<td>Construct PCC Median Surfacing</td>
<td>Square Foot</td>
</tr>
<tr>
<td>Construct PCC Mow Strip</td>
<td>Square Foot</td>
</tr>
<tr>
<td>Construct ___” PCC Multi-Use Trail</td>
<td>Square Foot</td>
</tr>
</tbody>
</table>
504 PCC Curb Ramp

504.01 General

A. Description

This work includes grading, forming, placement of concrete, and installation of precast detectable warning panels to construct the various types of PCC curb ramps in accordance with the Contract Documents or as directed by the Engineer. Curb ramps with detectable warnings shall be constructed where a sidewalk enters a street and any signalized or signed entrances/driveways.

B. Submittal Requirements

Refer to Section 500.01 B for submittal requirements.

504.02 Material Requirements

A. General

Refer to Section 500.02 for general material requirements, in addition to the following requirements.

B. Pre-cast Detectable Warning Panels

Pre-cast detectable warning panels shall be in accordance with the pattern, dimensions, and specifications identified within the most current version of the Accessibility Guidelines for Pedestrian Facilities in the Public Rights of Way as defined by the United States Access Board. Domes shall be aligned on a square grid, aligned in rows parallel and perpendicular to the predominant direction of travel. The domes must not be skewed diagonally to the direction of travel.

Pre-cast detectable warning panels shall be a “Red Brick” color. The color shall be integral with the warning panel. Paint or stain coating shall not be used. The Contractor shall submit a sample of the precast detectable warning panel to the Engineer.

The Contractor and manufacturer shall jointly warrant the installed detectable warning panel to last no less than two (2) years without loss of more than one (1) percent of the truncated domes due to product failure and shall further warrant the panel for a minimum of five (5) years against fading, chipping, peeling, cracking or loss of original shade due to sunlight, salt or exposure to weathering.

Only pre-approved pre-cast detectable warning panels shall be used. A current listing can be obtained by contacting the City of Omaha Public Works Department.

504.03 Construction Requirements

A. General

Refer to Section 500.03 for general construction requirements, in addition to the following requirements.

B. PCC Curb Ramps

Construct PCC curb ramps to be in accordance with the lines and grades indicated in the City of Omaha’s Standard Plates for Public Works Construction, Plate 500-82. Locate curb ramps to avoid inclusion of utility appurtenances or manholes within the curb ramp or landing area unless otherwise directed by the Engineer. Any utility appurtenance or manhole within the ramp or landing area shall be adjusted to match the plane of the finished surface.
The joint between the ramp and landing shall be formed prior to placement of the concrete. Pour either the ramp or landing separately, or use a false form to be removed after strike off. Use of grade stakes along this joint shall not be allowed.

Where maximum slope requirements are shown, the tolerance for determining compliance with such requirements shall be zero (+0.0) percent. In no case shall maximum indicated slopes be exceeded. Curb ramps constructed with slopes exceeding the maximum specified slopes shall not be opened to traffic and shall be removed and reconstructed at no additional cost to the City. Minimum slope of the ramp shall be no less than one (1) percent directed towards the street.

Stamps or other similar methods for constructing truncated domes shall not be used.

Detectable warning panels shall be installed in accordance with the manufacturer’s recommendations. After the detectable warning panel is installed the concrete surrounding the panel shall be refinished to remove any shoving of the concrete, bumps or depressions that may have formed.

Detectable warning panels shall be protected by a physical barrier during the curing application process. After the installation of the detectable warning panels, remove any debris, concrete, or excess sealant from the surface in accordance with the manufacturer’s recommendations.

After the installation of the detectable warning panel, the surface of the panel shall be undamaged and free of any debris, concrete, curing compound, or sealant. Damaged or marred panels shall be cleaned according to the manufacturer’s recommendations or removed and replaced if cleaning is ineffective or not feasible.

504.04 Acceptance

The Engineer shall observe the work to check for compliance with the Contract Documents. Perform corrective action or removal and replacement activities at no additional cost to the City. PCC curb ramps shall be constructed to the minimum compressive strength requirements identified in the Contract Documents. The Engineer shall verify the compressive strength of the concrete in accordance with the City of Omaha Materials and Testing Manual for Public Works Construction. Refer to Section 500.03.M for pavement smoothness and crack tolerances. Pavement shall be repaired in accordance with Section 500.03.M for final acceptance. Refer to Section 501 for compressive strength requirements and pay factor calculations. Backfill shall be constructed to the minimum compaction requirements identified in the Contract Documents. The Engineer shall verify the compaction of the backfill in accordance with the City of Omaha Materials and Testing Manual for Public Works Construction.

504.05 Measurement and Payment

Unless otherwise indicated in the Contract Documents, construction of PCC curb ramps and detectable warning panels is subsidiary to items for which the Contract provides direct payment.

Measurement and payment for imprinted surfacing, sidewalk, and multi-use trail shall be in accordance with Section 503.05.

The Engineer shall measure PCC curb ramps for payment by the square feet of curb ramp constructed, backfilled, and accepted. Unless otherwise indicated in the Contract Documents, landing and/or maneuvering areas at the top of the curb ramp shall be measured as sidewalk or multi-use trail. The limits and dimensions of curb ramps and maneuvering areas shall be in accordance with Standard Plate 504-01.
When indicated in the Contract Documents, the Engineer shall measure detectable warning panels for payment by the square feet of two (2) feet by four (4) feet detectable warning panel supplied, installed, and accepted.

Payment shall be made under the following unless otherwise indicated in the Contract Documents. The Contract Price shall be full compensation for all excavation and grading, disposing of excess material, saw-cutting, removals, forming, placing PCC, construction of the ramp wings, installation of the pre-cast detectible warning panel, backfilling, grading, and for furnishing all labor, materials, forms, joint material, reinforcement, equipment, protection, tools, traffic control devices, and all incidentals necessary to complete the work.

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construct PCC Curb Ramp</td>
<td>Square Foot</td>
</tr>
<tr>
<td>Construct Detectable Warning Panel</td>
<td>Square Foot</td>
</tr>
</tbody>
</table>
SECTION 600 – STRUCTURAL CONSTRUCTION

600   Structural Construction

600.01   General

A. Description

The information, submittal and material requirements, and construction requirements shall apply to all subsections within Section 600 unless otherwise specified. This section includes structures, barriers, sheet pile, concrete box culverts, guardrail, segmental retaining walls, reinforced retaining walls, stairs, and railings. A Professional Civil or Structural Engineer licensed in the State of Nebraska shall design any structure(s) and/or structural element(s) for which the Contract Documents do not provide structural design. Unless otherwise indicated in the Contract Documents, refer to the Nebraska Department of Transportation (NDOT) for bridge specifications and construction requirements.

B. Submittal Requirements

The Contractor shall submit, in accordance with the General Conditions, the following submittals:

1. PCC Barrier
   a. Rebar shop drawings and material certifications.
   b. Precast shop drawings and material certifications.

2. Sheet Pile
   a. Material shop drawings and material certifications.
   b. Dewatering permit if applicable.

3. Box Culverts
   a. Rebar shop drawings and material certifications.
   b. Precast shop drawings and material certifications.
   c. Q-Cast Certification for RC box culverts.
   d. Dewatering permit and/or stream diversion plan, if applicable.

4. Guardrail
   a. Material shop drawings and certifications for rail, posts, blocks, and hardware, and the manufacturer’s installation recommendations.

5. Segmental Retaining Wall
   a. A Professional Civil or Structural Engineer licensed in the State of Nebraska shall design the SRW in accordance with the recommendations of the current edition of the National Concrete Masonry Association (NCMA) Design Manual for Segmental Retaining Walls. The SRW shall have a minimum design life of seventy-five (75) years. The SRW design shall be specific to the project application, manufacturer, and type of system proposed. Submit all design plans and calculations to the Engineer for review.
b. Material shop drawings, material certifications, and the manufacturer’s installation recommendations.

6. **Gravity Block Retaining Wall – Large Block**
   a. A Professional Civil or Structural Engineer licensed in the State of Nebraska shall design the precast modular block (PMB) wall in accordance with the recommendations of the current edition of the National Concrete Masonry Association (NCMA) Design Manual for Segmental Retaining Walls. The PMB shall have a minimum design life of seventy-five (75) years. The PMB design shall be specific to the project application, manufacturer, and type of system proposed. Submit all design plans and calculations to the Engineer for review.
   b. Material shop drawings, material certifications, and the manufacturer’s installation recommendations.

7. **PCC Retaining Wall**
   a. Rebar shop drawings and material certifications.
   b. Precast shop drawings and material certifications.

8. **PCC Stairs**
   a. Rebar shop drawings and material certifications.

9. **Railing**
   a. Material shop drawings and material certifications.

### 600.02 Material Requirement

Material requirements shall be in accordance with Section 500, except as modified herein.

**A. Portland Cement for PCC**

Portland cement shall conform to the requirements for Cement Type I or Cement Type II in accordance with ASTM C150, Specification for Portland Cement, including Table 1, Table 2 (Maximum Equivalent Alkalis requirements only), and Table 3. Do not use blended hydraulic cements without prior approval of the Engineer. Blended hydraulic cements shall be in accordance with ASTM C595, Standard Specification for Blended Hydraulic Cements.

**B. Reinforcement for PCC**

Steel bars shall be deformed steel bars in accordance with ASTM A615, Standard Specification for Deformed and Plain Billet Steel Bars for Concrete Reinforcement; or ASTM A996, Standard Specification for Rail Steel and Axle Steel Deformed Bars for Concrete Reinforcement. Do not use Grade 50 or Grade 60 rail steel bars for tie bars that are bent or straightened during construction. Only bars designated in the Contract Documents to be field bent shall be modified in such a manner. All bars designated as having a bend shall be modified in accordance with the manufacturer’s instructions. For construction requiring field-bent tie bars, use Grade 60 tie bars in accordance with ASTM A615, Standard Specification for Deformed and Plain Billet Steel Bars for Concrete Reinforcement. Keep reinforcing metal clean and free of rust or foreign material. Protect reinforcing materials from weather until placement.
C. **PCC Mix Proportioning**

Proportion PCC mixtures to meet the requirements of Table 600.01. "M" designation indicates Type II cement and the addition of anti-microbial admixture, and shall be used for all storm and sanitary sewer structures.

<table>
<thead>
<tr>
<th>Mix Type</th>
<th>L65</th>
<th>L65M</th>
<th>L75M</th>
<th>L85M</th>
</tr>
</thead>
<tbody>
<tr>
<td>Portland Cement Content, lbs. per cubic yard</td>
<td>611 min.</td>
<td>611 min.</td>
<td>705 min.</td>
<td>799 min.</td>
</tr>
<tr>
<td>Coarse Aggregate, % of Total Aggregate</td>
<td>30±3</td>
<td>30±3</td>
<td>30±3</td>
<td>30±3</td>
</tr>
<tr>
<td>Fine Aggregate, % of Total Aggregate</td>
<td>70±3</td>
<td>70±3</td>
<td>70±3</td>
<td>70±3</td>
</tr>
<tr>
<td>Maximum Water Cement Ratio</td>
<td>0.42</td>
<td>0.42</td>
<td>0.40</td>
<td>0.38</td>
</tr>
<tr>
<td>Minimum 28-Day Compressive Strength, psi</td>
<td>4000</td>
<td>4000</td>
<td>4500</td>
<td>5000</td>
</tr>
<tr>
<td>Entrained Air Content, %</td>
<td>6.5±1.0</td>
<td>6.5±1.0</td>
<td>6.5±1.0</td>
<td>6.5±1.0</td>
</tr>
<tr>
<td>Slump, inches</td>
<td>2.5±1.5</td>
<td>2.5±1.5</td>
<td>2.5±1.5</td>
<td>2.5±1.5</td>
</tr>
<tr>
<td>PCC Temperature during placement, (°F)</td>
<td>70±20</td>
<td>70±20</td>
<td>70±20</td>
<td>70±20</td>
</tr>
</tbody>
</table>

**Referenced Test Procedures:**
- ASTM C231, Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
- ASTM C173, Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.

D. **Grout**

Refer to Section 700 for grout material requirements.

**600.03 Construction Requirements**

Construction requirements shall be in accordance with Section 500, except as modified herein.

**A. Excavation**

Excavate the structure to the outline and elevations indicated in the Contract Documents or as directed by the Engineer including any additional excavation necessary for constructing the structure. Do not round or undercut footing corners or edges. Smooth the footing bed to conform to the lines, grades, and dimensions of the footings. The Engineer reserves the right to alter the bottom elevation of the footings as necessary to satisfy changes in dimensions and/or footing elevations or to place the footing on satisfactory soils. When the Engineer determines that the soils encountered will not provide adequate support for the structure, over-excavate to a width and depth as directed by the Engineer. Replace over-excavated material to the established elevation using a material as directed by the Engineer. Replace unnecessary over-excavation at no additional cost to the City.

It shall be the Contractor’s responsibility to protect excavations in accordance with all federal, state, and local laws and regulations. Provide all sheeting, bracing, piling, dewatering, and shoring necessary to protect the excavation and all adjacent structures. Any damage to the work or to adjacent structures resulting from failure of excavation walls shall be repaired by the contractor.
Contractor at no additional cost to the City. Do not excavate beyond the bottom elevation indicated in the Contract Documents of any footings, walls, floors, etc., of an adjacent structure without written approval from the Engineer.

Accomplish excavation in a manner that does not create collected or standing water at any place on the site during construction. The excavation shall be wide enough to allow thorough compaction of the backfill adjacent to the lower portion of the structure. The minimum width of the excavation shall be four (4) feet wider than the maximum horizontal width of the structure.

B. Dewatering

Dewatering shall be performed in accordance with Section 700.

C. Forms for PCC

Use forms comprised of metal, wood, or other material. Do not use forms comprised of aluminum. Forms shall be mortar-tight, produce a uniform surface texture and appearance, and be sufficiently rigid to prevent distortion due to pressures of PCC, vibration, and other loads associated with construction operations. Anchor forms as necessary to maintain shape. Joints shall be tight and cut smooth. Wood forms shall be finished on the PCC side of the form and maintained to prevent warping and opening of joints due to shrinkage of lumber. Align consecutive wood forms to match the joints and grain of the wood. Use the same form material for all structures constructed on the project. Do not use form materials that are not in good condition, including form materials that are warped or bulged.

Construct the forms to permit removal of any ties or anchors contained within the forms to a minimum depth of one (1) inch beneath the surface of the PCC without injury to the PCC.

Do not place forms on pedestals to maintain proper grade. Remove and reset forms that vary more than one-fourth (¼) inch in ten (10) feet from line or grade. Remove any dirt, sawdust, or other extraneous materials from the forms before placing the PCC. Treat form surfaces with form oil to prevent bonding of the PCC to the forms. Such material shall not adhere to or discolor the PCC surface. Locate weep holes as indicated in the Contract Documents. Construct a PCC header sized and located as indicated in the Contract Documents.

D. Reinforcement for PCC

The Contractor shall protect reinforcing steel from damage at all times. When placed in the work, the reinforcing steel shall be free from dirt, paint, grease, oil, rust, or other foreign substances. Tightly adhered, powdery rust on steel is not harmful to concrete bond and will not normally require removal. However, the Engineer shall be the final judge as to acceptability of the reinforcing material's condition. Reinforcement with any appreciable reduction in section dimensions caused by corrosion will be rejected.

The Contractor shall place all reinforcement in the position shown in the Contract Documents, and it shall be held securely in position. Reinforcing bars shall be tied at all intersections, except when the spacing is less than one (1) foot in each direction, in which case alternate intersections shall be tied.

The Contractor shall position steel reinforcement in structures at the proper clearance from forms by chairs, stays, and/or hangers. Supports shall not be spaced at distances greater than four (4) feet. Properly sized supports shall be furnished in sufficient numbers, manufactured to serve their intended purpose, and capable of carrying imposed loads without measurable deflection or displacement of the reinforcing steel. The type and adequacy of supporting units
shall be at least equal to that recommended by the Concrete Reinforcing Steel Institute’s Manual of Standard Practices. Bar supports which are at exposed concrete surfaces shall be corrosion resistant as prescribed in the Concrete Reinforcing Steel Institute’s Manual of Standard Practice.

The Contractor shall furnish all reinforcing steel in full lengths, except where splices are indicated in the Contract Documents. Splices in adjacent bars shall be staggered. The Contractor shall splice bars by lapping the ends. The overlap length shall be as shown in the Contract Documents. Lapped splices shall be made by securely wiring the bars in contact, maintaining alignment and clearances. Spiral reinforcement shall be held in place by wiring to the main reinforcing. Pitch shall be maintained by adequate spacers. Splices shall be made by lapping one and one-half (1.5) turns.

The Contractor shall notify the Engineer for inspection of the reinforcement twenty-four (24) hours before final forming and placement of the PCC is scheduled to occur.

E. Joints

Joints shall be square and normal to the forms. Finish the face edges of all exposed joints true to line and elevation. Locate joints as indicated in the Contact Documents. Construction joints shall not allow movement of abutting surfaces. They shall be made only where located in the Contract Documents. The face edges of all joints shall be carefully finished true to line and elevation.

F. PCC Placement

Check the form tightness before placing new PCC on or against hardened PCC. Clean the hardened PCC surface and remove any loose particles or damaged portions of the hardened PCC. Moisten the surface of the hardened PCC with water before placing fresh PCC. Do not place PCC on frozen materials, and all surfaces contacting the PCC shall be at or above thirty-two (32) degrees Fahrenheit, including any reinforcing steel tie bars.

Use chutes and/or pipes to convey PCC from the mixer or transport vehicle to the forms. Extend chutes or pipes inside the forms or through holes left in the form as necessary. Do not allow the PCC to drop a distance greater than five (5) vertical feet. Remove any hardened PCC or other debris before using chutes and pipes. Adjust the chute or pipe discharge ends to facilitate proper PCC placement.

Place PCC using pumping equipment as necessary. Do not use components comprised of aluminum or aluminum alloy to convey the PCC. Pumping equipment shall introduce, transport, and discharge the PCC continuously without segregating or introducing air pockets into the material. Do not place the PCC materials used to prime the pumping equipment. Waste such material until the PCC discharged is uniform with the other material in the pumping system. Perform all testing on PCC material after discharging the material from the pumping equipment.

Place the PCC in continuous horizontal layers from joint to joint, at a maximum depth of twenty (20) inches per layer unless otherwise indicated in the Contract Documents. Place PCC in each part of the forms as near to the final position as possible. Consolidate the PCC under and around the reinforcement bars without displacing them. Stop monolithic placements at a vertical bulkhead. Avoid splattering forms or reinforcement bars with PCC when such splattering may harden before incorporation into the mass. Regulate PCC placement to prevent the fluid PCC pressure from exceeding the values used in designing the forms.
A minimum of two (2) tube vibrators shall be required to be maintained and available during any PCC placement operation. Use a manual tube vibrator with a minimum length equal to the height of the forms for all formed placements. Place and Consolidate each layer before the preceding layer has taken initial set.

When PCC placement is interrupted by thirty (30) minutes or less, remove all dried PCC particles and any other foreign material from the face of the PCC placement before resuming any placement. When placement is interrupted by more than thirty (30) minutes, place a transverse construction joint extending the full width and depth of the placement. Locate the transverse construction joint in the placed PCC at the location of the closest joint indicated in the Contract Documents. Remove any PCC accumulations from exposed reinforcement without incorporating such accumulations into the fresh PCC or damaging hardened PCC or the PCC-reinforcement bond.

The Contractor shall furnish heating equipment and/or enclose and protect the structure in such a way that the concrete and air surrounding shall be maintained at a temperature between fifty (50) degrees and one-hundred (100) degrees Fahrenheit for the first seventy-two (72) hours after the concrete has been placed. The Contractor shall assume all risk connected with the placing of concrete during freezing weather, and permission given by the Engineer to placing concrete during such time will in no way relieve the Contractor of the responsibility for satisfactory results. Any concrete showing damage from freezing shall be rejected.

For colored PCC applications and imprinted applications, prepare a complete test sample of the PCC for approval by the Engineer before commencing construction of the colored or imprinted PCC.

G. Form Removal
Remove forms as soon as practicable and safe to permit the required surface finishing. In cold weather operations, do not remove forms when the ambient air temperature is less than forty (40) degrees Fahrenheit without protecting the exposed PCC surface. Do not use form removal methods that may overstress or otherwise damage the PCC. Immediately following the removal of forms, remove all fins, ties, and irregular projections from all exposed surfaces.

H. PCC Surface Finish
Finish all PCC surfaces in accordance with the Contract Documents. Repair any cavities, holes, honeycomb spots, broken corners or edges, and other defects by cleaning, saturating with water, and filling with a non-shrinking grout or mortar by pointing and truing. Finish the grout or mortar to obtain a sound, smooth, and uniform surface. All construction and expansion joints in the completed work shall be carefully tooled and free of all grout, mortar, and concrete.

I. Soil Backfill
Backfill shall be in accordance with Section 200.

J. Flowable Fill Backfill
Flowable fill shall be in accordance with Section 200. Inspect the structure before commencing backfilling operations to verify that the structure has not settled, is undamaged, and in the proper alignment.

K. Defective or Substandard Structural Construction
The Engineer reserves the right to reject structures not meeting the requirements of the Contract Documents. The Engineer reserves the right to reject structures damaged by
movement and/or removal of the forms. Remove and replace any portion(s) of the structure that contain random cracking, plastic shrinkage cracking, scaling, spalls, honeycombs, high spots, depressions, or other defects or substandard conditions as determined by the Engineer at no additional cost to the City. The Contractor is responsible for any damage to the structure due to weather conditions or other factors.
601  PCC Barrier

601.01  General
A.  Description
This work includes constructing and installing cast-in-place or precast PCC barrier, end, and transition sections along the lines and grades, and in accordance with the details in the Contract Documents or as directed by the Engineer.

B.  Submittal Requirements
Refer to Section 600.01 B for submittal requirements.

601.02  Material Requirements
A.  General
Refer to Section 600.02 for general material requirements.

601.03  Construction Requirements
A.  General
Refer to Section 600.03 for general construction requirements, in addition to the following requirements.

The Contractor may submit revised designs for approval before building the barriers. The only changes that may be authorized are to the section’s casting and attachments or holes used to facilitate handling and lifting. If approved, the concrete sections must still meet all of the test and performance requirements unless specifically released in the approval letter.

The Contractor shall take care during storage, hoisting, and handling of precast units to prevent cracking or damage. Units damaged shall be replaced by the Contractor at no additional cost to the City.

Each individual section of concrete barrier shall have a uniform color and texture so that the completed concrete barrier has a uniform appearance. All forms shall be metal except for end and transition sections. If precast units are provided for permanent installation, all lift slots and dowel holes shall be grouted.

601.04  Acceptance
The Engineer shall observe the work to check for compliance with the Contract Documents. The Engineer may accept repairs for minor chipping and spalling. PCC barrier shall be constructed to the minimum compressive strength requirements identified in the Contract Documents. The Engineer shall verify the compressive strength of the concrete in accordance with the City of Omaha Materials and Testing Manual for Public Works Construction.

601.05  Measurement and Payment
The Engineer shall measure PCC barriers for payment by the linear feet of barrier supplied, constructed, and accepted. Replace any damaged precast barrier units at no additional cost to the City.

The Engineer shall measure PCC barrier end sections for payment by each barrier end section supplied, constructed, and accepted.
The Engineer shall measure PCC barrier transition sections for payment by each barrier transition section supplied, constructed, and accepted.

The Engineer shall measure temporary PCC barrier sections for payment by each barrier section supplied, installed, maintained, and removed. Temporary end sections and transition sections shall be considered subsidiary to items for which the Contract provides direct payment.

Payment shall be made under the following unless otherwise indicated in the Contract Documents. The Contract Price shall be full compensation for the cost for all forming, PCC placement, reinforcement, and dowel bars; for transporting and placing if precast units are utilized; for all grouting; and for all labor, materials, equipment, tools, and all incidentals necessary to complete the work.

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construct PCC Barrier</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Construct PCC Barrier End Section</td>
<td>Each</td>
</tr>
<tr>
<td>Construct PCC Barrier Transition Section</td>
<td>Each</td>
</tr>
<tr>
<td>Provide Temporary PCC Barrier Section</td>
<td>Each</td>
</tr>
</tbody>
</table>
602  Sheet Piling

602.01  General
   A.  Description
       This work includes supplying and installing permanent sheet piling along the lines and grades
       indicated in the Contract Documents or as directed by the Engineer.
   B.  Submittal Requirements
       Refer to Section 600.01 B for submittal requirements.

602.02  Material Requirements
   A.  General
       Refer to Section 600.02 for general material requirements, in addition to the following
       requirements.
   B.  Sheet Pile
       Sheet pile and sheet pile corners shall be in accordance with ASTM A328, Standard Specification
       for Steel Sheet Piling.

602.03  Construction Requirements
   A.  General
       Refer to Section 600.03 for general construction requirements, in addition to the following
       requirements.

       Using equipment designed and having adequate capacity to perform the work, drive sheet piles
       to the required elevation or until obtaining practical refusal above the required elevation. Install
       sheet piles in the required position vertically or to the batter indicated in the Contract
       Documents. The maximum allowable variation from vertical or batter line indicated shall be two
       (2) percent. The maximum allowable elevation deviation between each sheet pile, at the top,
       shall be two (2) inches. The maximum allowable deviation from line for adjacent sheet pile tops
       shall be one (1) inch. Remove and replace any broken, split, or improperly installed sheet piles
       at no additional cost to the City.

       Remove and replace sheet pile driven below the required elevation at no additional cost to the
       City. The Engineer reserves the right to allow such sheet piles to remain in-place with a full splice
       and extension installed.

       Correct, or remove and replace, any previously driven sheet pile vertically or horizontally
       displaced beyond the maximum allowable deviation during installation of subsequent sheet
       piles at no additional cost to the City.

602.04  Acceptance
       The Engineer shall observe the work to check for compliance with the Contract Documents.

602.05  Measurement and Payment
       The Engineer shall measure permanent sheet piles for payment by the square feet of exposed and
       unexposed sheet pile supplied, constructed, and accepted. Sheet piles installed beyond the lines
       and grades indicated in the Contract Documents, unless otherwise approved in writing by the
       Engineer, shall be considered subsidiary to items for which the Contract provides direct payment.
Unless otherwise indicated in the Contract Documents, sheet piles supplied and installed for temporary use shall not be measured separately and shall be considered subsidiary to items for which the Contract provides direct payment.

Payment shall be made under the following unless otherwise indicated in the Contract Documents. The Contract Price shall be full compensation for splices, extensions, and for furnishing all labor, materials, equipment, tools, and all incidentals necessary to complete the work.

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construct Sheet Pile</td>
<td>Square Foot</td>
</tr>
</tbody>
</table>
Concrete Box Culverts

General

A. Description
This work includes constructing and/or installing box culverts including excavation, backfill, and other related items along the lines and grades indicated in the Contract Documents or as directed by the Engineer.

B. Submittal Requirements
Refer to Section 600.01 B for submittal requirements.

Material Requirements

A. General
Refer to Section 600.02 for general material requirements, in addition to the following requirements.

B. Precast Reinforced PCC Structures, Box Culverts, Fittings, and Outlet Structures
Precast reinforced PCC box sections shall be in accordance with ASTM C1433, Standard Specification for Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers. Three (3) sided precast PCC structures shall be in accordance with ASTM C1504, Standard Specification for Manufacture of Precast Reinforced Concrete Three-Sided Structures for Culverts, Storm Drains, and Sewers.

All reinforced concrete structures shall be manufactured by a plant certified under the American Concrete Pipe Association’s (ACPA) “Quality Cast” Plant Certification Program. All reinforced concrete structures delivered to the jobsite shall be stamped with the “Q-Cast” certification stamp. Visual inspections for defects shall continue to take place on the site.

C. Aggregate Bedding Material
Aggregate bedding material requirements shall be in accordance with Section 700. The gradation shall be nominal maximum size of one and one-half (1½) inches in accordance with Table 700.02.

D. Portland Cement for PCC
Portland cement shall be in accordance with Section 600.

E. Flowable Fill Mix Proportioning and Required Properties
Flowable fill mix proportioning shall be in accordance with Section 200.

Construction Requirements

A. General
Refer to Section 600.03 for general construction requirements, in addition to the following requirements.

B. Bedding
Bed all structures in accordance with the Contract Documents and manufacturer’s recommendations. Bedding material shall extend the full width of the excavation and to a depth as detailed in the Contract Documents. Place and compact the aggregate bedding material in
six (6) inch maximum lifts. The Contractor shall perform compaction efforts using mechanical methods.

C. Precast Box Culvert Installation

Install precast box culverts at the locations and elevations indicated in the Contract Documents, and in accordance with ASTM C1479, Standard Practice for Installation of Precast Concrete Sewer, Storm Drain, and Culvert Pipe Using Standard Installations.

Assemble precast box culverts in accordance with the manufacturer’s instructions. Handle and place the box culverts in a manner that avoids damaging the box culvert sections, adjacent sections, excavation walls, or bedding material. Inspect the box culvert for damage or defects before commencing installation. Replace any damaged or defective box culvert sections at no additional cost to the City. Install box culverts only when weather and soil conditions are suitable to provide an acceptable product. Take all measures necessary to prevent water from filling the excavation and conduct operations in a manner that prevents box culvert floatation. Brace or anchor the box culvert to prevent displacement after establishing final position.

D. Cast-In-Place Box Culvert Installation

Construct cast-in-place box culverts at the locations and elevations indicated in the Contract Documents.

603.04 Acceptance

The Engineer shall observe the work to check for compliance with the Contract Documents. Backfill shall be constructed to the minimum compaction requirements identified in the Contract Documents. The Engineer shall verify the compaction of the backfill in accordance with the City of Omaha Materials and Testing Manual for Public Works Construction. Cast-in-place box culverts shall be constructed to the minimum compressive strength requirements identified in the Contract Documents. The Engineer shall verify the compressive strength of the concrete in accordance with the City of Omaha Materials and Testing Manual for Public Works Construction.

603.05 Measurement and Payment

The Engineer shall measure box culverts for payment by the linear feet of the size and type of box culvert supplied, constructed, and accepted. The Engineer shall conduct measurements along the centerline of the floor of the box culvert from the start of the box culvert to end of box culvert excluding any wing walls, cut-off walls, or other inlet or outlet structures. Unless otherwise indicated in the Contract Documents, inlet or outlet structures, including wing walls, cut-off walls, dissipation structures, etc. will not be measured separately and shall be considered subsidiary to items for which the Contract provides direct payment.

Replace unnecessary over-excavation at no additional cost to the City. Unless otherwise indicated in the Contract Documents, all costs associated with excavation and/or over-excavation for installation of the structure; protection of an excavation; de-watering; cofferdams or cribs; supplying additional material for, and completion of, backfilling operations; manipulation of existing materials; intermixing of existing materials with borrow materials, and/or replacing existing materials with borrow materials are subsidiary to items for which the Contract provides direct payment.

Payment shall be made under the following unless otherwise indicated in the Contract Documents. The Contract Price shall be full compensation for furnishing and placing reinforcing steel; for excavation, bedding, backfill, iron castings and other component materials; for the disposal of
surplus excavated materials; and for furnishing all forms, labor, materials, equipment, tools, and all incidentals necessary to complete the work.

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construct ____ Box Culvert</td>
<td>Linear Foot</td>
</tr>
</tbody>
</table>
604 Guardrail

604.01 General

A. Description
This work includes furnishing and erecting guardrails and guard posts at locations indicated in the Contract Documents or as directed by the Engineer. W-beam and thrie-beam guardrail shall consist of rigid beam elements bolted to the posts with offset blocks. Cable guardrail shall consist of three (3) wire cables supported by cable mounts that are attached to steel posts.

B. Submittal Requirements
Refer to Section 600.01 B for submittal requirements.

604.02 Material Requirements

A. General
Refer to Section 600.02 for general material requirements.

B. Steel Posts, Guardrail, and Hardware
Steel beams used for posts shall be “W6 X 9” sections and in accordance with ASTM A36, Standard Specification for Carbon Structural Steel; ASTM A588, Standard Specification for High Strength Low Alloy Structural Steel, up to 50 ksi Minimum Yield Point, with Atmospheric Corrosion Resistance; or ASTM A242, Standard Specification for High Strength Low Alloy Structural Steel.

W-beam and thrie-beam guardrail shall be Type 1 Class A in accordance with AASHTO M180, Standard Specification for Corrugated Sheet Steel Beams for Highway Guardrail.

Bolts shall be galvanized and Grade A in accordance with ASTM A307, Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.

Anchor rods and plates shall be in accordance with ASTM A36, Standard Specification for Carbon Structural Steel.

Turnbuckles and clevises shall be Class B in accordance with ASTM A668, Standard Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use.

Posts, blocks, plates, and hardware fabricated from ASTM A36 steel shall be galvanized in accordance with ASTM A123, Standard Specification for Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products.

C. Wood Posts and Offset Blocks
All wood components shall be in accordance with ASTM D245, Standard Practice for Establishing Structural Grades and Related Allowable Properties for Visually Graded Lumber.

Round wood posts shall be Douglas Fir or Southern Yellow Pine species in accordance with ANSI 05.1, Specifications and Dimensions for Wood Poles. Sawn wood posts shall be Select Structural Douglas Fir or Dense Structural 65 Southern Yellow Pine in accordance with ANSI 05.1, Specifications and Dimensions for Wood Poles.

Wood offset blocks shall be Grade 2 in accordance with ANSI 05.1, Specifications and Dimensions for Wood Poles.
Posts and blocks shall be treated in accordance with AASHTO M133, Standard Specification for Preservatives and Pressure Treatment Processes for Timber. Creosote treatment shall not be allowed.

604.03 Construction Requirements

A. General
Refer to Section 600.03 for general construction requirements, in addition to the following requirements.

B. Post Installation
The Contractor shall set all posts plumb, firm, and spaced to the lines and grades as indicated in the Contract Documents.

The Contractor may elect to drive, rather than set, the posts in pre-bored holes. Posts damaged when driven into the ground shall be rejected, removed, and replaced with acceptable materials. Should the Engineer determine that damage is occurring to the surfaced shoulder during post placement due to the Contractor’s driving operation, the Engineer will require that the post holes be dug.

All areas where the surface of treated timber is broken by cutting, boring, or other means shall be thoroughly coated with three (3) applications of the original preservative. Each application should be dry before the next coat is applied. Bearing plates or washers shall be positioned as shown in the Contract Documents and placed under all heads, nuts, and bolts which have bearing on wood posts.

Steel intermediate posts for cable guardrail may be either driven or placed in predrilled holes. Steel posts that are driven should be protected with a device to prevent deformation of the post. Cable guardrail end posts shall be installed in pre-excavated holes. Any damage to galvanizing shall be repaired.

Sections of steel “W” beams [W6 x 9 steel posts] will be allowed as an alternative to treated timber posts. Any damage to galvanizing shall be repaired.

When posts are required in a surfaced area, the Contractor shall backfill all post holes. The material shall be compacted leaving a space eight (8) inches deep around the post. This remaining part of the hole shall be backfilled with granular material, bituminous material, or flowable fill placed to the elevation of the surrounding surfacing in accordance with the Contract Documents. The material near the post shall be sloped to help any water run-off away from the post. Posts placed in other than bituminous and concrete surfacing shall be backfilled and compacted to the elevation of the existing surface.

C. Cable Guardrail
The Contractor shall install cable guardrail and all associated hardware in accordance with the Contract Documents. The cable shall be drawn taut and fastened securely on both ends in accordance with the Contract Documents. All cable shall be installed with the turnbuckles near the midpoint of take-up or release to provide future adjustments.

Intermediate anchors and terminal anchors shall be installed at the locations indicated in the Contract Documents.
D. W-Beam and Thrie-Beam Guardrail

The Contractor shall assemble “W” and “thrie”-beam guardrail using galvanized steel beams mounted in accordance with the Contract Documents. Each end of all “W” and “thrie”-beam guardrails shall be fitted with a terminal end section formed in accordance with the Contract Documents. The beam elements shall be straight and of uniform section, except those elements which must be manufactured to be curved shapes as indicated in the Contract Documents. Warped or deformed elements will be rejected. All connections and splices shall be formed with flat round-headed bolts or bolts with heads of similar detail so that no appreciable projection will obstruct a vehicle sliding along the rail. The edges of the beam elements shall be smooth after fabrication.

The Contractor shall install bridge approach sections at the locations indicated and in accordance with the Contract Documents. Bridge approach sections shall be mounted directly to the bridge with existing bolts or through special curb mountings or flush mountings shown in the Contract Documents. Curb mountings, anchor bolts, and incidentals will be considered as part of the bridge approach sections. The Contractor shall furnish and install, at designated locations, special guardrail posts, fittings, and hardware as prescribed in the Contract Documents. The finish will also be prescribed in the plans.

The Contractor shall furnish and install, at designated locations, special guardrail posts, fittings, and hardware as indicated in the Contract Documents. The Contractor shall furnish and install all terminal sections at designated locations in accordance with the Contract Documents.

604.04 Acceptance

The Engineer shall observe the work to check for compliance with the Contract Documents. Concrete foundations shall be constructed to the minimum compressive strength requirements identified in the Contract Documents. The Engineer shall verify the compressive strength of the concrete in accordance with the City of Omaha Materials and Testing Manual for Public Works Construction.

604.05 Measurement and Payment

The Engineer shall measure cable guardrails for payment by the linear feet of cable guardrail supplied, constructed, and accepted. The Engineer shall conduct measurements from center to center of end posts and shall not include the length of any section of cable elements projecting beyond the end posts. Such projection is subsidiary to items for which the Contract provides direct payment. Special guardrail posts, brackets, blocks, or fittings furnished and installed in conjunction with cable guardrail are subsidiary to items for which the Contract provides direct payment.

The Engineer shall measure beam guardrails for payment by the linear feet of the type of beam guardrail supplied, constructed, and accepted. The Engineer shall conduct measurements from center to center of end posts and shall not include the length of the section of beam element projecting beyond these points. Such projection is subsidiary to items for which the Contract provides direct payment. Special guardrail posts, brackets, blocks, or fittings furnished and installed in conjunction with beam or safety beam guardrail installations are subsidiary to items for which the Contract provides direct payment.

The Engineer shall measure terminal sections for payment by each terminal section supplied, constructed, and accepted.
Unless otherwise indicated in the Contract Documents, all costs associated with backfilling of the posts; supply and installation of necessary mounting hardware; and surface repair of wood and steel materials are subsidiary to items for which the Contract provides direct payment.

Payment shall be made under the following unless otherwise indicated in the Contract Documents. The Contract Price shall be full compensation for all materials, fabrication, shop work, transportation and erection of beam rail, posts, blocks, anchors, end sections, and fittings; for post removal, excavation, backfilling, storing, preparation, erection, and galvanizing; and for furnishing all labor, materials, equipment, tools and all incidentals necessary to complete the work.

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construct Cable Guardrail</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Construct ___-Beam Guardrail</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Construct Terminal Section</td>
<td>Each</td>
</tr>
</tbody>
</table>
605 Segmental Retaining Walls

605.01 General

A. Description
This work includes designing, supplying, and constructing a segmental retaining wall (SRW) along the lines and grades indicated in the Contract Documents or as directed by the Engineer. Do not construct segmental retaining walls within the Right-of-Way or a City of Omaha Easement without obtaining written permission from the Engineer.

B. Submittal Requirements
Refer to Section 600.01 B for submittal requirements.

605.02 Material Requirements

A. General
Refer to Section 600.02 for general material requirements, in addition to the following requirements. The following material requirements are minimum requirements and shall be used unless otherwise indicated in the segmental retaining wall (SRW) design submittal.

B. Segmental Retaining Wall (SRW) Unit
SRW Units shall be in accordance with National Concrete Masonry Association (NCMA) TEK 2-4, Specification for Segmental Retaining Wall Units; ASTM C1372, Standard Specification for Segmental Retaining Wall Units; and Table 605.01.

<table>
<thead>
<tr>
<th>Property</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum 28-Day Compressive Strength, psi</td>
<td>3,000</td>
</tr>
<tr>
<td>Maximum Absorption,pcf</td>
<td>13</td>
</tr>
<tr>
<td>Freeze/Thaw Weight Loss, %</td>
<td>2.5 ± 1.5</td>
</tr>
<tr>
<td>Maximum Width Deviation, inch</td>
<td>± 1/8</td>
</tr>
<tr>
<td>Maximum Depth Deviation, inch</td>
<td>± 1/8</td>
</tr>
<tr>
<td>Maximum Height Deviation, inch</td>
<td>± 1/8</td>
</tr>
</tbody>
</table>

C. Drainage Collection Pipe
Drainage collection pipe shall be PVC or corrugated HDPE pipe that is perforated or slotted. Drainage collection pipe shall be in accordance with ASTM D3034, Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; or AASHTO M252, Corrugated Polyethylene Drainage Pipe.

D. Drainable Fill Material
Drainable fill material shall be clean, free-draining aggregate comprised of locally available granular fill or crushed stone in accordance with the manufacturer’s recommendations.

E. Backfill
Backfill material shall be inorganic soils classified as GP, GW, SW, SP, or SM in accordance with ASTM D2487, Standard Practice for Classification of Soils for Engineering Purposes (Unified Soils Classification System).
F. Geotextile Filter
Geotextile filter shall meet the requirements specified in the SRW design.

G. Cap Adhesive
Cap adhesive shall meet the requirements of the SRW unit manufacturer.

605.03 Construction Requirements

A. General
Refer to Section 600.03 for general construction requirements, in addition to the following requirements.

B. Engineering Support
The SRW system supplier shall provide a qualified and experienced representative to assist the Contractor regarding proper wall installation during construction.

C. Grading
Excavate to the lines and grades indicated in the Contract Documents or as directed by the Engineer. Do not over-excavate unless otherwise directed by the Engineer. Design and provide excavation support as needed at no additional cost to the City. The SRW qualified representative shall examine the foundation soils for compliance with the bearing strength requirements established during the design. Unsuitable material shall be handled in accordance with Section 200 or as directed by the SRW qualified representative.

D. Leveling Pad
The leveling pad shall consist of a minimum of six (6) inches of compacted drainage aggregate placed and compacted to the grades shown in the SRW design submittal. The Contractor shall perform compaction efforts using mechanical methods or as indicated in the SRW design submittal.

E. SRW Construction
Install all SRW units in accordance with the manufacturer’s recommendations and the SRW design submittal. In case of conflicting requirements, the SRW design shall govern. Repair or discard damaged units and replace at no additional cost to the City.

The allowable tolerance relative to the wall design verticality or batter is a maximum of one (1) inch in ten (10) feet and three (3) inches maximum for the SRW.

F. Drainage Collection Pipe and Drainable Fill Placement
Place the drainage collection pipe and drainable fill as directed by the manufacturer’s recommendations and the SRW design. Install drainage collection pipes to maintain gravity flow. Drainage collection pipe(s) shall discharge at location indicated in the Contract Documents.

G. Cap Block Placement
Place and bond the cap block in accordance with the manufacturer’s recommendations.

H. Backfill Placement
Construct the backfill in lifts not to exceed six (6) inches and in accordance with the SRW design submittal. Place, spread, and compact the material in a manner that does not wrinkle or displace the geosynthetic reinforcement or SRW units. The Contractor may operate rubber-
tired construction equipment directly on the geosynthetic reinforcement at speeds less than ten (10) miles per hour without unnecessary sudden braking or sharp turning. Do not use tracked construction equipment without a minimum of six (6) inches of backfill cover. Remove and replace or repair any damaged or displaced geosynthetic reinforcement at no additional cost to the City.

605.04 Acceptance

The Engineer shall observe the work to check for compliance with the Contract Documents. Backfill shall be constructed to the minimum compaction requirements identified in the Contract Documents. The Engineer shall verify the compaction of the backfill in accordance with the City of Omaha Materials and Testing Manual for Public Works Construction.

605.05 Measurement and Payment

The Engineer shall measure segmental retaining walls for payment by the square feet of retaining wall constructed, backfilled, and accepted. The Engineer shall conduct measurements along the exposed face of the wall after completion of final grading activities. The Engineer shall conduct measurements from the top of the retaining wall to the top of the finish grade and from end to end.

Payment shall be made under the following unless otherwise indicated in the Contract Documents. The Contract Price shall be full compensation for providing a qualified and experienced representative from the SRW system supplier; all excavation, embankment, benching, shoring, dewatering, leveling pad, SRW units, all necessary backfill, drainage collection pipe and fill, supplying additional material for completion of backfilling operations, manipulation of existing materials; and for furnishing all labor, materials, equipment, tools, and all incidentals necessary to complete the work.

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construct Segmental Retaining Wall</td>
<td>Square Foot</td>
</tr>
</tbody>
</table>
606 Gravity Block Retaining Walls – Large Block

606.01 General

A. Description

This work includes designing, supplying, and constructing a precast modular block wall (PMB) along the lines and grades indicated in the Contract Documents or as directed by the Engineer. Do not construct precast modular block walls within the Right-of-Way or a City of Omaha Easement without obtaining written permission from the Engineer.

B. Submittal Requirements

Refer to Section 600.01 B for submittal requirements.

606.02 Material Requirements

A. General

Refer to Section 600.02 for general material requirements, in addition to the following requirements. The following material requirements are minimum requirements and shall be used unless otherwise indicated in the precast modular block wall (PMB) design submittal.

B. Precast Modular Block Wall (PMB) Unit

PMB Units shall be in accordance with Table 606.01.

<table>
<thead>
<tr>
<th>Property</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum 28-Day Compressive Strength, psi</td>
<td>4,000</td>
</tr>
<tr>
<td>Maximum Width Deviation, inch</td>
<td>±(\frac{1}{2})</td>
</tr>
<tr>
<td>Maximum Depth Deviation, inch</td>
<td>±(\frac{1}{2})</td>
</tr>
<tr>
<td>Maximum Height Deviation, inch</td>
<td>±(\frac{3}{16})</td>
</tr>
</tbody>
</table>

C. Geosynthetic Reinforcement

Geosynthetic reinforcement shall meet the requirements specified in the PMB design.

D. Drainage Collection Pipe

Drainage collection pipe shall be PVC or corrugated HDPE pipe that is perforated or slotted. Drainage collection pipe shall be in accordance with ASTM D3034, Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; or AASHTO M252, Corrugated Polyethylene Drainage Pipe.

E. Drainable Fill Material

Drainable fill material shall be clean, free-draining aggregate comprised of locally available granular fill or crushed stone in accordance with the manufacturer’s recommendations.

F. Backfill

Backfill material shall be inorganic soils classified as GP, GW, SW, SP, or SM in accordance with ASTM D2487, Standard Practice for Classification of Soils for Engineering Purposes (Unified Soils Classification System).
G. Geotextile Filter
Geotextile filter shall meet the requirements specified in the PMB design.

H. Cap Adhesive
Cap adhesive shall meet the requirements of the PMB unit manufacturer.

606.03 Construction Requirements
A. General
Refer to Section 600.03 for general construction requirements, in addition to the following requirements.

B. Engineering Support
The PMB system supplier shall provide a qualified and experienced representative to assist the Contractor regarding proper wall installation during construction.

C. Grading
Excavate to the lines and grades indicated in the Contract Documents or as directed by the Engineer. Do not over-excavate unless otherwise directed by the Engineer. Design and provide excavation support as needed at no additional cost to the City. The PMB qualified representative shall examine the foundation soils for compliance with the bearing strength requirements established during the design. Unsuitable material shall be handled in accordance with Section 200 or as directed by the PMB qualified representative.

D. Leveling Pad
The leveling pad shall consist of a minimum of six (6) inches of compacted drainage aggregate placed and compacted to the grades shown in the PMB design submittal. The Contractor shall perform compaction efforts using mechanical methods or as indicated in the PMB design submittal.

E. PMB Construction
Install all PMB units in accordance with the manufacturer’s recommendations and the PMB design submittal. In case of conflicting requirements, the PMB design shall govern. Repair or discard damaged units and replace at no additional cost to the City.

Install geosynthetic reinforcement in accordance with the manufacturer’s recommendations and the PMB design submittal.

The allowable tolerance relative to the wall design verticality is a maximum of one and one-half (1½) inch in twelve (12) feet and three (3) inches maximum for the PMB.

The allowable tolerance relative to the wall design batter is two (2) degrees from the design batter and two (2) degrees minimum for the PMB.

F. Drainage Collection Pipe and Drainable Fill Placement
Place the drainage collection pipe and drainable fill as directed by the manufacturer’s recommendations and the PMB design. Install drainage collection pipes to maintain gravity flow. Drainage collection pipe(s) shall discharge at location indicated in the Contract Documents.

G. Cap Block Placement
Place and bond the cap block in accordance with the manufacturer’s recommendations.
H. Backfill Placement

Construct the backfill in lifts not to exceed six (6) inches and in accordance with the PMB design submittal. Place, spread, and compact the material in a manner that does not wrinkle or displace the geosynthetic reinforcement or PMB units. The Contractor may operate rubber-tired construction equipment directly on the geosynthetic reinforcement at speeds less than ten (10) miles per hour without unnecessary sudden braking or sharp turning. Do not use tracked construction equipment without a minimum of six (6) inches of backfill cover. Remove and replace or repair any damaged or displaced geosynthetic reinforcement at no additional cost to the City.

606.04 Acceptance

The Engineer shall observe the work to check for compliance with the Contract Documents. Backfill shall be constructed to the minimum compaction requirements identified in the Contract Documents. The Engineer shall verify the compaction of the backfill in accordance with the City of Omaha Materials and Testing Manual for Public Works Construction.

606.05 Measurement and Payment

The Engineer shall measure gravity block retaining walls for payment by the square feet of retaining wall constructed, backfilled, and accepted. The Engineer shall conduct measurements along the exposed face of the wall after completion of final grading activities. The Engineer shall conduct measurements from the top of the retaining wall to the top of the finish grade and from end to end.

Payment shall be made under the following unless otherwise indicated in the Contract Documents. The Contract Price shall be full compensation for providing a qualified and experienced representative from the PMB system supplier; all excavation, embankment, benching, shoring, dewatering, leveling pad, PMB units, all necessary backfill, geosynthetic reinforcement, drainage collection pipe and fill, supplying additional material for completion of backfilling operations, manipulation of existing materials; and for furnishing all labor, materials, equipment, tools, and all incidentals necessary to complete the work.

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construct Gravity Block Retaining Wall</td>
<td>Square Foot</td>
</tr>
</tbody>
</table>
607 Reinforced PCC Retaining Walls

607.01 General
A. Description
This work includes furnishing the material and constructing a reinforced PCC retaining wall along the lines and grades indicated in the Contract Documents or as directed by the Engineer. Do not construct retaining walls within the Right-of-Way or a City of Omaha Easement without obtaining written permission from the Engineer.

B. Submittal Requirements
Refer to Section 600.01 B for submittal requirements.

607.02 Material Requirements
A. General
Refer to Section 600.02 for general material requirements.

607.03 Construction Requirements
A. General
Refer to Section 600.03 for general construction requirements.

607.04 Acceptance
The Engineer shall observe the work to check for compliance with the Contract Documents. Retaining walls shall be constructed to the minimum compressive strength requirements identified in the Contract Documents. The Engineer shall verify the compressive strength of the concrete in accordance with the City of Omaha Materials and Testing Manual for Public Works Construction. Backfill shall be constructed to the minimum compaction requirements identified in the Contract Documents. The Engineer shall verify the compaction of the backfill in accordance with the City of Omaha Materials and Testing Manual for Public Works Construction.

607.05 Measurement and Payment
The Engineer shall measure reinforced PCC retaining walls for payment by the cubic yards of reinforced retaining wall constructed, backfilled, and accepted. The Engineer shall determine the volume based upon measurements of the completed reinforced PCC wall.

Payment shall be made under the following unless otherwise indicated in the Contract Documents. The Contract Price shall be full compensation for all excavation, embankment, benching, shoring, dewatering, forming, reinforcement, weep holes, PCC placement; for all texturing, coloring, special finishing, and grouting; backfilling and compacting; supplying additional material for completion of backfilling operations; manipulation of existing materials; and for furnishing all labor, materials, equipment, tools, and all incidentals necessary to complete the work.

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construct Reinforced PCC Retaining Wall</td>
<td>Cubic Yard</td>
</tr>
</tbody>
</table>
608 PCC Stairs

608.01 General
   A. Description
   This work includes constructing cast-in-place PCC stairs along the lines and grades indicated in
   the Contract Documents or as directed by the Engineer.

   B. Submittal Requirements
   Refer to Section 600.01 B for submittal requirements.

608.02 Material Requirements
   A. General
   Refer to Section 600.02 for general material requirements. Handrail material requirements shall
   be in accordance with Section 609.02.

608.03 Construction Requirements
   A. General
   Refer to Section 600.03 for general construction requirements and Standard Plate 608-01. All
   stairs of four (4) risers or more shall require a handrail.

608.04 Acceptance
   The Engineer shall observe the work to check for compliance with the Contract Documents. Stairs
   shall be constructed to the minimum compressive strength requirements identified in the Contract
   Documents. The Engineer shall verify the compressive strength of the concrete in accordance with
   the City of Omaha Materials and Testing Manual for Public Works Construction. Backfill shall be
   constructed to the minimum compaction requirements identified in the Contract Documents. The
   Engineer shall verify the compaction of the backfill in accordance with the City of Omaha Materials

608.05 Measurement and Payment
   The Engineer shall measure PCC stairs for payment by the cubic yards of stairs constructed, finished,
   backfilled, and accepted. The Engineer shall determine volume based upon the dimensions and
   measurements in the Contract Documents and/or Standard Plate 608-01.
   Payment shall be made under the following unless otherwise indicated in the Contract Documents.
   The Contract Price shall be full compensation for all excavation, embankment, benching, shoring,
   dewatering, forming, reinforcement, PCC placement; backfilling and compacting; supplying
   additional material for completion of backfilling operations; manipulation of existing materials; and
   for furnishing all labor, materials, equipment, tools, and all incidentals necessary to complete the
   work.

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construct Reinforced PCC Stairs</td>
<td>Cubic Yard</td>
</tr>
</tbody>
</table>
609 Railings

609.01 General
   A. Description
       This work includes furnishing and installing handrail and/or railing at the locations indicated in
       the Contract Documents or as directed by the Engineer.
   B. Submittal Requirements
       Refer to Section 600.01 B for submittal requirements.

609.02 Material Requirements
   A. General
       Refer to Section 600.02 for general material requirements, in addition to the following
       requirements.
   B. Steel Pipe
       All steel pipe shall conform to the requirements for galvanized standard weight pipe in
       accordance with ASTM A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-
       Coated, Welded and Seamless.
   C. Aluminum Railings
       Aluminum castings shall conform to the requirements for Alloy S7A in accordance with ASTM
       shall conform to the requirements for Alloy 6061-T6 in accordance with ASTM B221, Standard
       Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes,
       except that a minimum elongation of ten (10) percent is required.
   D. Aluminum Capacity Plates
       Cast aluminum alloy for capacity plates shall conform to the requirements for Alloy S7A,
       Condition T6 in accordance with ASTM B108, Standard Specification for Aluminum-Alloy
       Permanent Mold Castings.
   E. Aluminum-Filled, Resilient Sealing Compound
       Aluminum-filled, resilient sealing compound shall be Minnesota Mining and Manufacturing
       Company (3M) Sealant Number 1168 or approved equal.
   F. Anchor Bolts
       Bolt, nut, and washer material shall conform to the requirements for Type 3 bolts in accordance
       with ASTM A325, Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi
       Minimum Tensile Strength.

609.03 Construction Requirements
   A. General
       Refer to Section 600.03 for general construction requirements, in addition to the following
       requirements.

       Use equipment, tools, and machinery designed for and having sufficient capacity for the
       intended use. All exposed metal surfaces shall be protected by paint, galvanizing, zinc-coating,
or other finish methods as indicated in the Contract Documents. Use the same type and manufacturer for all railing on a project unless otherwise indicated in the Contract Documents.

Construct railings along the lines and grades indicated in the Contract Documents. Install rail posts plumb or as indicated in the Contract Documents. Dress areas to receive rail posts to provide for an even bearing. Repair any damage to the protective coating(s) in accordance with the manufacturer’s recommendations.

Trim washers as necessary to meet available clearances. Do not trim washers closer than ninety (90) percent of the bolt diameter from the center of the washer. Where bearing faces of bolted parts are not parallel, use beveled washers.

609.04 Acceptance

The Engineer shall observe the work to check for compliance with the Contract Documents.

609.05 Measurement and Payment

The Engineer shall measure handrails for payment by the linear feet of the type of handrail supplied, constructed, and accepted. The Engineer shall conduct measurements from center of end post to center of end post as identified in the Contract Documents and along the slope of the rail. Overhang or end sections are subsidiary to items for which the Contract provides direct payment.

The Engineer shall measure railings for payment by the linear feet of the type of railing supplied, constructed, and accepted. The Engineer shall conduct measurements from center of end post to center of end post as identified in the Contract Documents and along the slope of the rail. Overhang or end sections are subsidiary to items for which the Contract provides direct payment.

Payment shall be made under the following unless otherwise indicated in the Contract Documents. The Contract Price shall be full compensation for all materials, fabrication, shop work, installation; paint and/or protective coatings; and for furnishing all labor, materials, equipment, tools, and all incidentals necessary to complete the work.

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construct ___ Handrail</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Construct ___ Railing</td>
<td>Linear Foot</td>
</tr>
</tbody>
</table>
SECTION 700 – SEWER/SUBSURFACE CONSTRUCTION

700 Sewer/Subsurface Construction

700.01 General

A. Description

The information, submittal requirements, material requirements, and construction requirements shall apply to all subsections within Section 700 unless otherwise specified. This section includes bedding and trench stabilization, storm sewers, culverts, sanitary sewers, manholes, inlets, structures and appurtenances, and trenchless pipe installation along the lines and grades indicated in the Contract Documents or as directed by the Engineer. This section also includes adjusting manholes and cleanouts to grade, external manhole frame seals, water service facilities, and sewer pipeline inspection using closed-circuit television (CCTV).

This specification is intended for gravity sewer applications and water service facilities. Combined sewers are classified as sanitary sewers.

B. Submittal Requirements

The Contractor shall submit, in accordance with the General Conditions, the following submittals:

1. Storm Sewer Pipe
   a. Bedding and trench stabilization material certifications, gradations, and unit weight.
   b. Pipe material certifications and manufacturer’s installation recommendations.
   c. Mix design for reinforced concrete pipe (RCP), including type of cement to be used.
   d. Q-Cast Certification for RCP storm sewer and reinforced concrete (RC) culvert pipe.
   e. Pipe layout diagram.
   f. Gasket certifications and manufacturer’s installation recommendations.
   g. Mastic and external wrap certifications and manufacturer’s installation recommendations.
   h. Pipe coupling certifications and manufacturer’s installation recommendations.
   i. Pipe plug certifications and manufacturer’s installation recommendations.
   j. Licensed sewer layer name and license number.
   k. Dewatering permits and bypass pumping plan.
   l. Trenchless pipe material certifications and manufacturer’s installation recommendations.
   m. Trenchless Pipe Installation Plan
      Trenchless pipe installation plan shall include, but not be limited to, proposed method of tunneling, equipment descriptions, production rates, safety plan, contingency plan, groundwater management, and support utilities.
   n. Air test pressure gauge certifications
The pressure test gauge shall have a maximum range of zero (0) to fifteen (15) pounds per square inch. Calibrate pressure test gauges in accordance with the gauge manufacturer's instructions. An independent calibration agency shall calibrate gauges at a maximum interval of one (1) time every twelve (12) months. Provide the gauge manufacturer and model number, and certification of calibration including date and expiration, to the Engineer before commencing air testing.

o. Sewer Pipeline Inspector Certification

Sewer inspection using closed circuit television (CCTV) shall be performed by trained operators that have successfully completed the National Association of Sewer Service Companies (NASSCO) Pipeline Assessment and Certification Program (PACP).

p. Storm sewer pipeline inspection report and video.

2. Sanitary Sewer Pipe

a. Bedding and trench stabilization material certifications, gradations, and unit weight.

b. Pipe material certifications and manufacturer’s installation recommendations.

c. Mix design for RCP, including type of cement and anti-microbial admixture used.

d. Q-Cast Certification for RCP sanitary sewer.

e. Pipe material composition for PVC, including percentage of additives and fillers.

f. Pipe design calculations for fiberglass pipe sealed by a Professional Engineer licensed in the State of Nebraska.

g. Pipe layout diagram.

h. Gasket certifications and manufacturer’s installation recommendations.

i. Pipe coupling certifications and manufacturer’s installation recommendations.

j. Pipe plug certifications and manufacturer’s installation recommendations.

k. Licensed sewer layer name and license number.

l. Dewatering permits and bypass pumping plan.

m. Plastic liner placement drawings.

n. Plastic liner material certifications.

Plastic lined pipe manufacturer shall submit the liner material certifications; lined pipe manufacturing method; shop drawing(s) of manufactured lined pipe; testing results after lined pipe manufacturing has been completed.

o. Plastic liner welder certifications for each welder and proposed standard welding procedure(s).

p. Trenchless pipe material certifications and manufacturer’s installation recommendations.

q. Trenchless Pipe Installation Plan

Trenchless pipe installation plan shall include, but not be limited to, proposed method of tunneling, equipment descriptions, production rates, safety plan, contingency plan, groundwater management, and support utilities.
r. Pipe deflection testing methods and equipment.

s. Air test pressure gauge certifications.

The pressure test gauge shall have a maximum range of zero (0) to fifteen (15) pounds per square inch. Calibrate pressure test gauges in accordance with the gauge manufacturer's instructions. An independent calibration agency shall calibrate gauges at a maximum interval of one (1) time every twelve (12) months. Provide the gauge manufacturer and model number, and certification of calibration including date and expiration, to the Engineer before commencing air testing.

t. Sewer Pipeline Inspector Certification.

Sewer inspection using closed circuit television (CCTV) shall be performed by trained operators that have successfully completed the National Association of Sewer Service Companies (NASSCO) Pipeline Assessment and Certification Program (PACP).

u. Sanitary sewer pipeline inspection and report.

3. Structures

a. Mix design for RC manhole sections, including type of cement used. For sanitary sewer RC manhole sections with anticipated exposure to high levels of hydro-sulfuric (H2S) acid (i.e. interceptor sewers, siphon structures, etc.), mix design shall also include the anti-microbial admixture used.

b. Q-Cast Certification for RC manholes.

c. Manhole material certifications and manufacturer’s installation recommendations.

d. Manhole appurtenance material certifications, including frames, covers, steps, external frame seals, and the manufacturer’s installation recommendations.

e. Manhole layout diagram, including locations, elevations on rims and inverts, penetration locations, and opening sizes.

f. Bedding and trench stabilization material certifications, gradations, and unit weight.

g. Mastic and external wrap certifications and manufacturer’s installation recommendations.

h. Grout material certifications and manufacturer’s installation recommendations.

i. Reinforcing steel material certifications and manufacturer’s installation recommendations.

j. Mix design for curb inlets, including type of cement and admixtures used.

l. Pre-cast inlet top material certifications and manufacturer’s installation recommendations.

700.02 Material Requirements

A. Pipe Manufacturing Facilities

Pipe manufacturing facilities shall have in place a certification program, which will provide the necessary testing and review of the pipe product(s) to assure the product(s) meet the applicable ASTM Standards. The Engineer reserves the right to inspect any sewer pipe manufacturing facility that intends to provide pipe for the project. The Engineer reserves the right to reject pipe manufactured from any facility.
B. Appurtenances

1. Concrete for Manholes, Collars, and Cradles

Concrete for manholes, collars, and cradles shall be in accordance with ASTM C94, Standard Specification for Ready Mixed Concrete, the properties of Table 700.01 for mix type L65M, and the material requirements of Section 500. "M" designation indicates Type II cement. Portland cement for sewer applications shall conform to the requirements for Type II Cement in accordance with ASTM C150, Standard Specification for Portland Cement, including Table 2 (Maximum Equivalent Alkalies requirements only) and Table 3.

<table>
<thead>
<tr>
<th>Mix Type</th>
<th>L65M</th>
<th>L75M</th>
<th>L85M</th>
</tr>
</thead>
<tbody>
<tr>
<td>Portland Cement Content, lbs. per cubic yard</td>
<td>611 min.</td>
<td>705 min.</td>
<td>799 min.</td>
</tr>
<tr>
<td>Coarse Aggregate, % of Total Aggregate</td>
<td>30±3</td>
<td>30±3</td>
<td>30±3</td>
</tr>
<tr>
<td>Fine Aggregate, % of Total Aggregate</td>
<td>70±3</td>
<td>70±3</td>
<td>70±3</td>
</tr>
<tr>
<td>Maximum Water Cement Ratio</td>
<td>0.42</td>
<td>0.40</td>
<td>0.38</td>
</tr>
<tr>
<td>Minimum 28-Day Compressive Strength, psi</td>
<td>4000</td>
<td>4500</td>
<td>5000</td>
</tr>
<tr>
<td>Air Content, %</td>
<td>6.5±1.0</td>
<td>6.5±1.0</td>
<td>6.5±1.0</td>
</tr>
<tr>
<td>Slump, inches</td>
<td>2.5±1.5</td>
<td>2.5±1.5</td>
<td>2.5±1.5</td>
</tr>
<tr>
<td>Concrete Temperature during placement, °F</td>
<td>70±20</td>
<td>70±20</td>
<td>70±20</td>
</tr>
</tbody>
</table>

Referenced Test Procedures:
- ASTM C39, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
- ASTM C231, Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
- ASTM C173, Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
- ASTM C143, Standard Test Method for Slump of Hydraulic Cement Concrete
- ASTM C1064, Standard Test Method for Temperature of Freshly Mixed Hydraulic Cement Concrete

2. Reinforcement for Manholes, Collars, and Cradles

Reinforcing steel shall be deformed steel bars in accordance with ASTM A615, Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement; or ASTM A996, Standard Specification for Rail Steel and Axle Steel Deformed Bars for Concrete Reinforcement. Do not use Grade 50 or Grade 60 rail steel bars for tie bars that are bent or straightened during construction. For construction requiring bent bars, use Grade 40 tie bars in accordance with ASTM A615, Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement.

C. Bedding and Trench Stabilization Material

1. Aggregate Bedding Material

Aggregate bedding material for RCP, PVC, DIP and Fiberglass pipe shall consist of crushed limestone, quartzite, or dolomite meeting the requirements for Class 1S coarse aggregate in accordance with ASTM C33, Standard Specification for Concrete Aggregates. The
bedding material shall conform to the gradation requirements of Table 700.02 or a locally available bedding gradation in accordance with the pipe manufacturer’s recommendations. Aggregate bedding material for VCP shall consist of crushed limestone meeting the requirements of Class I bedding material in accordance with ASTM C12, Standard Practice for Installing Vitrified Clay Pipe Lines, or a locally available bedding gradation in accordance with the pipe manufacturer’s recommendations. Recycled PCC is not an acceptable pipe bedding material for any pipe material.

<table>
<thead>
<tr>
<th>Table 700.02</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sewer Pipe Aggregate Gradation Requirements</td>
</tr>
<tr>
<td>For All Pipe Except Vitrified Clay Pipe</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Target Value</th>
<th>Tolerance</th>
<th>Target Value</th>
<th>Tolerance</th>
<th>Target Value</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 inch</td>
<td>95</td>
<td>±5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 ½ inch</td>
<td>80</td>
<td>±20</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1½ inch</td>
<td>100</td>
<td>0</td>
<td>40</td>
<td>±20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 inch</td>
<td>100</td>
<td>0</td>
<td>20</td>
<td>±20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>¾ inch</td>
<td>80</td>
<td>±15</td>
<td>5</td>
<td>±5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#4</td>
<td>40</td>
<td>±20</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>#10</td>
<td>15</td>
<td>±15</td>
<td>20</td>
<td>±10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#200</td>
<td>5</td>
<td>±5</td>
<td>5</td>
<td>±5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. **Trench Stabilization Material**

   Trench stabilization material shall be either aggregate bedding material or foundation rock in accordance with Standard Plate 701-01. Trench stabilization material is defined as material used from the bottom elevation of the pipe bedding and below. Excavated material for trench stabilization shall not be considered unsuitable material, and shall be considered subsidiary to items for which direct payment is made.

3. **Trench Excavation (Unsuitable Materials)**

   Unsuitable materials encountered during trench excavation shall include all materials that contain debris, roots, organic or frozen materials, stone having a maximum dimension larger than six (6) inches, or any other materials determined by the Engineer to be unsuitable. Material with a moisture content not meeting the requirements of Table 200.01 shall not be classified as unsuitable materials unless the Engineer determines it cannot be manipulated, aerated, or blended with other materials. Manipulation and/or aeration shall be performed at no additional cost to the City. Blending of materials to alter moisture content shall be as directed by the Engineer. Unsuitable material may be any portion of the trench depth from the bottom of the aggregate bedding to the top of the trench. Excavated material for trench stabilization shall not be considered unsuitable.
material, and shall be considered subsidiary to items for which direct payment is made. Material used to replace unsuitable material shall be in accordance with Section 200.

D. **Biaxial Geotextile Grid**
   Biaxial geotextile grid shall be in accordance with Section 300.

E. **Geotextile Fabric**
   Geotextile fabric shall be in accordance with Section 300.

F. **Flowable Fill**
   Flowable fill shall be in accordance with Section 200.

G. **Pipe Plug**
   Unless otherwise indicated in the Contract Documents, pipe plugs shall be constructed in the field and shall be water tight. Material for pipe plugs shall consist of the following:

   1. **Brick**
      Brick shall be in accordance with ASTM C62, Standard Specification for Building Brick (Solid Masonry Units Made From Clay or Shale); or ASTM C32, Standard Specification for Sewer and Manhole Brick (Made From Clay or Shale).

   2. **Concrete Block**
      Concrete block shall be in accordance with ASTM C139, Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes.

   3. **Mortar**
      Mortar shall comply with the requirements for Mortar Type M or Type S in accordance with ASTM C270, Standard Specification for Mortar for Unit Masonry.

   4. **Small Diameter Pipe**
      For pipe sizes smaller than twelve (12) inches in diameter, expanding non-shrink grout shall be used to construct pipe plugs.

H. **Precast PCC Manholes**
   Precast PCC manhole components including bases, manhole sections, cones, and flattops shall be in accordance with ASTM C478, Standard Specification for Precast Reinforced Concrete Manhole Sections, with Type II cement. For sanitary sewer structures with anticipated exposure to high levels of hydro-sulfuric (H2S) acid (i.e. interceptor sewers, siphon structures, other locations as identified by the Engineer), mix design shall also include an anti-microbial admixture.

   All reinforced concrete manholes shall be manufactured by a plant certified under the American Concrete Pipe Association’s (ACPA) “Quality Cast” Plant Certification Program. All reinforced concrete manholes delivered to the jobsite shall be stamped with the “Q-Cast” certification stamp. Visual inspections for defects shall continue to take place on the site. The Engineer reserves the right to inspect any manhole manufacturing facility that intends to provide manhole components for the project. The Engineer reserves the right to reject manhole components manufactured from any facility.
I. Cast-In-Place Structures

1. PCC Proportioning
   Proportion PCC mixtures to meet the requirements of Table 700.01. Manufacture the PCC in accordance with ASTM C94, Standard Specification for Ready Mixed Concrete. "M" designation indicates Type II cement. For sanitary sewer structures with anticipated exposure to high levels of hydro-sulfuric (H2S) acid (i.e. interceptor sewers, siphon structures, other locations as identified by the Engineer), mix design shall also include an anti-microbial admixture.

2. PCC Materials
   Water, aggregates, forms, reinforcing steel, admixtures, and curing compounds shall be in accordance with the requirements of Section 600.

J. Riser Sections & Shims

1. Precast Riser Sections
   Precast concrete riser sections shall be manufactured in accordance with Standard Plates 702-11 and 703-03, and ASTM C478, Standard Specification for Precast Reinforced Concrete Manhole Sections.

2. Shims
   Shims for adjusting manhole frames to grade shall be rubber, plastic, or brick. Shims shall be removed after grout has been installed.

K. Castings

1. Ring and Cover
   Castings for rings and covers shall be in accordance with Standard Plate 700-05 and ASTM A48, Standard Specification for Gray Iron Castings.

2. Steps
   Step castings shall be in accordance with Standard Plate 700-06 and ASTM C478, Standard Specification for Precast Reinforced Concrete Manhole Sections. Co-polymer polypropylene plastic shall be in accordance with ASTM D4101, Standard Specification for Polypropylene Injection and Extrusion Materials. Deformed reinforcing bars shall have a minimum diameter of one-half (½) inch and shall conform to the requirements for a Grade 60 deformed steel bar in accordance with ASTM A615, Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement.

L. Frame Seals and Extensions
   Only pre-approved frame seals shall be used. A current listing can be obtained by contacting the City of Omaha Public Works Department. Frame seals shall be required on newly constructed manholes in accordance with Section 700.03 S.

M. Manhole Shrink Wrap
   Manhole shrink wrap material shall be heat-shrinkable sleeves coated with protective heat-activated adhesive and be capable of bonding to primed concrete, metal and fiberglass surfaces.

N. Grout
   Grout for filling the void under the manhole frame after adjusting to paving grade shall be a pre-mixed, non-metallic, high strength, non-shrink grout and shall be in accordance with ASTM
C476, Standard Specification for Grout for Masonry. The minimum compressive strength shall be six thousand (6,000) pounds per square inch at twenty-four (24) hours and nine thousand (9,000) pounds per square inch at twenty-eight (28) day compressive strength. The maximum height of adjustment shall be two (2) inches.

700.03 Construction Requirements

A. Storage and Handling

The Contractor shall store materials and equipment at locations shown in the Contract Documents. If storage locations are not indicated in the Contract Documents, materials shall be stored within the project limits. The Contractor shall restore or repair any damage to such storage areas upon completion of the work. The Contractor shall obtain any additional storage space necessary at no additional cost to the City.

Handle the pipe and manhole sections in such a manner as to avoid damage. Damaged pipe and manhole sections include any pipe or manhole section with a defect that materially affects the pipe’s or manhole’s ability to function as intended. When directed by the Engineer, damaged pipe and manhole sections shall be removed and replaced at the Contractor’s expense. Flexible pipe shall be stored in a manner to prevent deformation and to prevent exposure to sunlight.

B. Equipment

Use equipment in working condition and designed for use in the manner proposed. Use compaction equipment and techniques that consistently produce the required compaction throughout the depth of the compacted lift. Do not use compaction equipment that produces a smooth, glossy surface or detrimental laminations within the compacted lifts. Drop hammers or hydraulic hammers shall not be used. Boring operations shall use a machine designed for rotary type boring.

Use techniques that avoid damaging utilities located within the limits of the proposed construction. Notify the Engineer of any utilities that interfere with the proposed work. Repair any damage to the utilities or related services to the satisfaction of the utility owner at no additional cost to the City.

C. Castings

Manufacture the castings true to pattern in accordance with Standard Plate 700-05. The finished metal surface shall be clean and free of surface defects that impair serviceability. Finished metal surfaces shall not contain blow or sand holes or plugged or filled holes. Remove all parting fins and pouring gates before delivery to the project. Clean and shot blast the finished metal before delivery to the project.

D. General Installation

The Foreman or Superintendent responsible for and directing any work related to sanitary and storm sewer applications shall be a Licensed Sewer Layer as defined in the Municipal Code of Omaha, Nebraska, Chapter 49, Article II Licensing, Division 5 Sewer Layers.

All cast-in-place concrete shall be in accordance with the construction requirements of Section 500. No backfill shall be allowed within twenty-four (24) hours of construction.

E. Excavation

Excavate the trench to the lines, grades, and tolerances required by the Contract Documents or as directed by the Engineer. Begin excavating trenches at the downstream end and proceed toward the upstream end. Do not begin the excavation for pipes placed in embankment until
completing such embankment to an elevation above or equal to the top of the pipe. The maximum allowable length of an open or unfilled trench shall be three hundred (300) feet. The Engineer reserves the right to further limit the maximum allowable length as deemed necessary. Safety or construction fence shall be used to protect all unattended excavations from entry by non-authorized personnel. The maximum allowable length of an open or unfilled trench at the completion of the working day, or when operations are suspended for a period longer than four (4) hours, shall be twenty-five (25) feet.

The Contractor shall meet the requirements of 29 CFR Part 1926, Safety and Health Regulations for Construction, for excavation safety. Provide all sheeting, bracing, piling, and shoring necessary to protect the excavation and all adjacent structures. Any damage to the work or to adjacent structures resulting from failure of excavation walls shall be the Contractor's responsibility. The cost of protection of excavations or structures is subsidiary to items for which the Contract provides direct payment.

Do not excavate beyond the bottom elevation as indicated in the Contract Documents. Unless otherwise indicated in the Contract Documents or directed by the Engineer, excavation beyond the trench excavation details shall be considered subsidiary to other items for which direct payment is made. The minimum and maximum width of the trench shall be in accordance with Standard Plate 701-01. Remove any unsuitable material as indicated in the Contract Documents or as directed by the Engineer.

F. Dewatering

All excavation areas shall be kept free from water, including but not limited to groundwater and rainwater. The Contractor shall obtain dewatering permits in accordance with federal, state, and local regulations. All water generated from dewatering activities shall be disposed of in accordance with the dewatering permit. Accomplish dewatering without damaging any downstream conveyance or properties. Unless otherwise stated in the Contract Documents, dewatering shall be subsidiary to other items for which direct payment is made.

G. Bedding

Bedding shall be constructed in accordance with the Contract Documents and Standard Plate 701-01. Place and compact the aggregate bedding material in six (6) inch maximum lifts. The Contractor shall perform compaction efforts using mechanical methods. Shape the bed to fit the pipe and any bell or connecting bands.

Bedding for structures shall consist of aggregate bedding as detailed on Standard Plates 702-11 and 703-03. Place and compact the aggregate bedding material in six (6) inch maximum lifts. The Contractor shall perform compaction efforts using mechanical methods.

Flowable fill used as bedding shall be in accordance with the Contract Documents, Section 200 and Standard Plate 701-01. Inspect the pipe before commencing flowable fill placement operations to verify that all pipes are undamaged, in the proper alignment, and have not settled. Before commencing placement of the flowable fill, take all necessary steps to assure that placement of the flowable fill does not damage or displace the pipe. Flowable fill shall be directed to the top of the pipe to flow down equally on both sides. Remove and relay any pipes that have settled, become damaged, or out-of-alignment at no additional cost to the City.

H. Trench Stabilization

The limits of over-excavation shall be as directed by the Engineer. Trench stabilization construction shall be in accordance with Standard Plate 701-01. Unless otherwise indicated in
the Contract Documents, over-excavation for trench stabilization and disposal of over-excavated material shall be subsidiary to items for which the Contract provides direct payment. Install biaxial geotextile grid and geotextile fabric in accordance with Standard Plate 701-01 and Section 300. Place and compact foundation rock or additional aggregate bedding as directed by the Engineer. The Contractor shall perform compaction efforts using mechanical methods.

I. Pipe Installation

Trenchless sewer pipe installation shall be in accordance with Section 704. Before installing pipe, inspect the pipe for cracks or other damage. Damaged pipe includes any pipe with a defect that materially affects the pipe’s ability to function as intended. Damaged pipe shall not be installed and shall be removed from the site and replaced at the Contractor’s expense. Install pipe at the locations and along the lines and grades indicated in the Contract Documents. The Contractor shall be responsible for verifying the alignment and elevation of installed pipe during installation and prior to backfill operations. Handle and place the pipe in a manner that avoids damaging the pipe or bedding material.

Clean the interior of all pipe, fittings, and joints before installation. Use lubricants, primers, adhesives, tools, methods, and equipment as recommended by the pipe or joint manufacturer. Pipe cut in the field shall be smooth and free of burrs and sharp edges.

Install pipe sections when weather and soil conditions are suitable to provide an acceptable product. Install the pipe in the trench with the bell or groove end or the outside circumferential lap facing upstream. Verify that each segment of the pipe contacts the bedding material throughout the full length. If present, verify the pipe flared end section contacts the bedding material for all its length but at the end where it is fully supported on its foundation. Take all measures necessary to prevent water from filling the trench and conduct operations in a manner that prevents pipe flotation. Brace or anchor each pipe section to prevent displacement after establishing final installation position. Place and compact the remaining aggregate bedding in accordance with Standard Plate 701-01. Place bedding in six (6) inch maximum lifts. The Contractor shall perform compaction efforts using mechanical methods.

Check the compliance of the joint opening, deflection, and gasket position before installing the next pipe section. Do not make more than one (1) correction for alignment or grade between manholes, inlets, or other similar structures. The pipe installation tolerance for horizontal alignment between structures shall be within three (±3) inches from proposed alignment. The pipe installation tolerance for grade between structures shall be within one (±1) inch from proposed grade. Joint deflection tolerance shall be per the manufacturer’s recommendations.

For sewers eight (8) inches to twelve (12) inches in diameter and slopes less than one and one-half (1½) percent, no more than two (2) sags of one (1) inch or less will be allowed between structures. For sewers greater than twelve (12) inches in diameter, sags will be evaluated by the Engineer and the City will have final determination for acceptance. Remove and replace, or otherwise repair, any sections of non-conforming pipe at no additional cost to the City.

J. Connections and Appurtenances Installation

1. General

Connect the pipe to existing structures or pipelines at the locations indicated in the Contract Documents or as directed by the Engineer. Construct connections between jacked and bored pipe and other pipe of different material using a concrete collar. Use adapters and concrete collars at the locations indicated in the Contract Documents or as directed by the Engineer. Prepare existing structures by cutting an opening with a minimum
clearance of two (2) inches on all sides. Position the pipe and fill the opening between pipe and structure using an expansive grout or rubber gasket. When flowable fill is used, all joints shall have gaskets.

2. **Flared End Sections**
   Flared end sections shall be installed at the locations indicated in the Contract Documents or as directed by the Engineer. Installation shall be in accordance with the construction requirements of Section 700.03 I.

3. **Cradles and Collars**
   Construct concrete cradles and concrete collars at the locations indicated in the Contract Documents or as directed by the Engineer. Concrete collars shall be in accordance with Standard Plate 700-01. Position and support the pipe using blocks to maintain position and prevent flotation. Construct forms as necessary for concrete placement. Longitudinal reinforcement shall be continuous through construction joints. Protect the concrete after finishing for a minimum of twenty-four (24) hours prior to placing backfill.

4. **Taps**
   Construct sewer taps at the locations indicated in the Contract Documents or as directed by the Engineer. Sewer and manhole taps shall be in accordance with Standard Plate 700-02. For pipes proposed to be tapped that are made from materials other than concrete, the Contractor shall provide a submittal for the proposed method of constructing the tap.

5. **Couplings**
   Install couplings at the locations indicated in the Contract Documents or as directed by the Engineer, and in accordance with the manufacturer’s installation recommendations.

6. **Pipe Plugs**
   Install pipe plugs at the locations indicated in the Contract Documents or as directed by the Engineer. Pipe plugs constructed in the field shall be constructed in accordance with Section 700 and Standard Plate 700-03. The Contractor shall take care not to dislodge any plugs during backfill operations.

7. **Stub-outs**
   Construct stub-outs at the locations indicated in the Contract Documents or as directed by the Engineer. The minimum length of the stub-out shall be five (5) feet and shall be the type and size of pipe indicated in the Contract Documents. Cut and grind the stub-out flush with the inside edge of the structure. Install a pipe plug on the end of the stub-out.

K. **Manhole Installation**

   1. **General**
      Construct manholes at the locations indicated in the Contract Documents or as directed by the Engineer. Handle and place the manhole sections in a manner that avoids damaging the manhole section, pipe, or bedding material. Before construction, inspect the manhole sections and adjacent pipe for cracks or other defects. Damaged manhole sections include any manhole section with a defect that materially affects the manhole’s ability to function as intended. Damaged manhole sections shall not be installed and shall be removed from the site and replaced at the Contractor’s expense. Do not support manhole sections using blocks.
Prevent water and foreign material from entering the manhole and adjacent pipe. Take all measures necessary to prevent water from filling the excavation and conduct operations in a manner that prevents flotation. Brace or anchor the structure to prevent displacement after establishing final position. Use lubricants, primers, adhesives, tools, and other equipment as recommended by the pipe or joint manufacturer. Cut pipe and smooth cuts by power grinding to remove burrs and sharp edges. Repair any damage to the pipe lining in accordance with the manufacturer’s recommendations.

Construct manholes built on an existing sewer without disrupting service or damaging the sewer. Complete the structure base, walls, and invert before removing the top half of the pipe unless otherwise indicated in the Contract Documents or as directed by the Engineer. Cover exposed rough edges of the cut pipe using joint mortar to produce a smooth finish. Repair or replace any damage to the sewer at no additional cost to the City.

The alignment and shape of the invert channels shall be as shown in the Contract Documents. Changes in flow direction shall be smooth, uniform, and made with the longest radius possible. The cross-sectional shape of invert channels shall match the lower halves of the entering and exiting pipes. The surfaces of the channels shall be steel troweled to produce a dense, smooth surface.

Set all manhole castings to the elevation required by the Contract Documents or as directed by the Engineer. Use precast concrete riser sections and shims to adjust manhole castings to grade. The maximum height of riser section adjustment above the cone or flat top section shall be thirty-six (36) inches. Install external frame seals on all new construction in accordance with Section 700.03.S unless otherwise indicated in the Contract Documents.

The height of final adjustment using shims shall be no more than two (2) inches. All voids shall be filled and consolidated with grout to the full depth of the riser sections. Shims shall be removed as the grout is installed.

The Contractor shall deliver broken or unserviceable manhole castings to the City Sewer Maintenance Yard and pick up replacements. This item will not be considered a pay item but will be considered an incidental item of work for adjusting the manhole to grade.

2. **Precast Concrete Manholes**

   Construct precast manholes at the locations indicated in the Contract Documents or as directed by the Engineer, and in accordance with the applicable Standard Plates. Precast manholes for round pipe shall be furnished with openings for the pipe penetrations. The maximum vertical joint opening between precast manhole sections shall be seven-sixteenth (7/16) inch.

3. **Cast-in-Place Manholes**

   Construct cast-in-place manholes at the locations indicated in the Contract Documents or as directed by the Engineer, and in accordance with the applicable Standard Plates. The cast-in-place base shall extend a minimum of six (6) inches above the exterior crown of the highest pipe. The top of “bird bath” cast-in-place concrete shall be level and the exterior circumference shall match the first precast manhole section. The joint between the precast section and base shall be sealed with bitumastic joint sealant and external sealing wrap.
L. Adjust Existing Manhole
Adjust existing manholes at the locations indicated in the Contract Documents or as directed by the Engineer. Adjustment of existing manhole is a modification that includes, but is not limited to, installation or removal of brick or riser section(s) less than two (2) feet of vertical height. Make final adjustments of existing manholes in accordance with Section 700.03 K.

M. Reconstruct Existing Manhole
Reconstruct existing manholes at the locations indicated in the Contract Documents or as directed by the Engineer. Reconstruction of existing manholes is a modification that includes, but is not limited to, installation or removal of brick or riser section(s) or barrel sections, greater than two (2) feet of vertical height. Make final adjustments of existing manholes in accordance with Section 700.03 K.

N. Junction Boxes
Construct junction boxes in accordance with the Contract Documents and Section 600.

O. Pipe Backfill
Backfill shall be in accordance with Section 200. Inspect the pipe before commencing backfilling operations to verify that all pipes are undamaged, in the proper alignment, and have not settled. Remove and relay any pipes that have settled, become damaged, or out-of-alignment at no additional cost to the City. Do not backfill concrete encasements or collars for twenty-four (24) hours after PCC placement.

P. Flowable Fill Trench Backfill
Flowable fill for trench backfill shall be in accordance with Section 200. Place flowable fill to three (3) feet below the proposed finished elevation of the surrounding ground.

Q. Backfill for Structures
Backfill for structures shall be in accordance with Section 200. Inspect the structures before commencing backfilling operations to verify that all structures are undamaged, in the proper alignment, and have not settled. Avoid damaging the exterior of the structure, external frame seals, or external sealing wraps during backfilling. Immediately repair any damage to the damp-proof coating without additional cost to the City.

R. Adjustment Risers
Concrete riser sections installed to raise the manhole to grade shall be of the largest vertical dimension possible. The use of multiple riser sections of lesser dimensions where a riser with a greater vertical dimension may have been utilized is not acceptable and shall be subject to rejection. Construct riser sections accordance with Standard Plates 702-11 and 703-03.

S. Frame Seals and Extensions Installation
All sealing surfaces shall be reasonably smooth and circular, clean and free of any loose material or excessive voids, and uniformly vertical. Use a wire brush or other means acceptable to the Engineer, to remove loose or protruding mortar, brick, or other material from the frame, chimney, cone, or corbel that may interfere with the performance of the frame seal, extensions, or wedge. Fill voids flush with the surrounding surface using mortar. Use mortar to construct a uniformly vertical three (3) to four (4) inch wide surface for the sleeve and extensions to seal against as necessary. All surfaces shall conform to the manufacturer’s recommendations.

Install external frame seals in accordance with the Contract Documents. At a minimum, install external frame seals on all newly constructed sanitary manholes. At a minimum, install external
frame seals on all newly constructed storm sewer manholes located in paved areas, unless the manhole frame is integrally cast into the manhole top. Install frame seals upon completion of the construction of the manhole and frame structure. Do not install frame seals when the frame is more than two (2) inches out of alignment with the chimney, cone, or corbel unless otherwise directed by the Engineer. Install frame seals and interlocking extensions in accordance with the manufacturer's recommendations. Position the seal and extension(s) tight against the manhole and frame surfaces with the expansion or tightening bands securely locked in-place and extending from the frame down to the bottom of the chimney or the top of the cone or corbel. Install the seals in a manner that eliminates voids or leakage points along the perimeter. Reinstall or replace any seal that fails to eliminate voids or leakage at no additional cost to the City.

The Engineer may allow installation of twelve (12) inch wide shrink wrap in lieu of frame seals on existing manholes. Manhole shrink wrap shall be installed in accordance with the manufacturer’s recommendations. The manhole shrink wrap shall be allowed to cool before backfilling operations commence. Cooling methods shall be in accordance with the manufacturer’s recommendations.
701 Aggregate Bedding and Trench Stabilization

701.01 General

A. Description

This works includes the aggregate bedding and trench stabilization for storm and sanitary sewer pipe and associated structure construction as indicated in the Contract Documents or as directed by the Engineer.

B. Submittal Requirements

Refer to Section 700.01 B for submittal requirements.

701.02 Material Requirements

A. General

Refer to Section 700.02 for general material requirements.

701.03 Construction Requirements

A. General

Refer to Section 700.03 for general construction requirements.

701.04 Acceptance

The Engineer shall observe the work to check for compliance with the Contract Documents. Aggregate bedding shall be constructed to the minimum thickness identified in the Contract Documents and Standard Plate 701-01. When requested by the Engineer, the Contractor shall expose and verify the thickness of the aggregate bedding in accordance with the City of Omaha Materials and Testing Manual for Public Works Construction. Aggregate bedding shall be constructed to the minimum compaction requirements identified in the Contract Documents. The Engineer shall verify the compaction of the aggregate bedding in accordance with the City of Omaha Materials and Testing Manual for Public Works Construction.

701.05 Measurement and Payment

The Engineer shall measure aggregate bedding for payment by the linear feet of the type of bedding and size and type of pipe installed, compacted, and accepted, in accordance with Sections 702 and 703. Aggregate bedding installed for manholes, appurtenances and structures shall be subsidiary to items for which the Contract provides direct payment.

The Engineer shall measure aggregate bedding for trench stabilization for payment by the cubic yards of aggregate bedding installed, compacted, and accepted. The dimensions the Engineer shall use for cubic yardage calculations shall be the minimum required depth, minimum trench width, and directed length of over-excavation. Over-excavation and disposal of material shall be considered incidental to aggregate bedding for trench stabilization.

The Engineer shall measure foundation rock for trench stabilization for payment by the cubic yards of foundation rock installed, compacted, and accepted. The dimensions the Engineer shall use for cubic yardage calculations shall be the minimum required depth, minimum trench width, and directed length of over-excavation. Over-excavation and disposal of material shall be considered incidental to foundation rock for trench stabilization.

The Engineer shall measure trench excavation (unsuitable material) for payment by the cubic yards of unsuitable material excavated, replaced, compacted, and accepted. The Engineer shall measure
the volume of unsuitable material excavated in its original position by the minimum required depth, minimum trench width, and directed length of excavation. The Engineer reserves the right to verify the unsuitable material excavation quantity by cross-sections or topographic survey. Overexcavation and disposal of material shall be considered incidental to trench excavation (unsuitable material).

Payment shall be made under the following unless otherwise indicated in the Contract Documents. The Contract Price shall be full compensation for excavation, over-excavation, unsuitable material excavation, disposal of excess excavated material, trench protection, de-watering, furnishing, placing, and compacting the material, exposing locations for thickness testing, and for furnishing all labor, materials, equipment, tools, and all incidentals necessary to complete the work.

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construct Aggregate Bedding for Type __ ___” Storm Sewer Pipe</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Construct Aggregate Bedding for Type __ ___” Sanitary Sewer Pipe</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Construct Aggregate Bedding for Type __ ___” VCP Sewer Pipe</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Construct Aggregate Bedding for Trench Stabilization</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>Construct Foundation Rock for Trench Stabilization</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>Construct Trench Excavation (Unsuitable Material)</td>
<td>Cubic Yard</td>
</tr>
</tbody>
</table>
702 Storm Sewer Pipe, Culverts, Manholes, and Inlets

702.01 General
   A. Description
      This work includes furnishing and constructing storm sewers, culverts, manholes, inlets, and
      appurtenances along the lines and grades indicated in the Contract Documents or as directed
      by the Engineer.
   B. Submittal Requirements
      Refer to Section 700.01 B for submittal requirements.

702.02 Material Requirements
   A. General
      Refer to Section 700.02 for general material requirements, in addition to the following
      requirements.
      Portland cement for storm sewer applications shall conform to the requirements for Type II
      Cement in accordance with ASTM C150, Standard Specification for Portland Cement, including
      Table 2 (Maximum Equivalent Alkalis requirements only) and Table 3.
   B. Storm Sewer Pipe and Fittings
      1. General
         Storm sewer pipe constructed within the right-of-way or an easement shall be reinforced
         concrete pipe (RCP), ductile iron pipe (DIP), or reinforced concrete box (RC Box). Culvert
         pipe constructed within the right-of-way or an easement shall be a minimum of fifteen (15)
         inches in diameter and be RCP, DIP, high-density polyethylene (HDPE) or high-density
         polypropylene (HDPP) pipe.
         For private use only, HDPE or HDPP pipe, up to sixty (60) inches in diameter, may be used
         within an easement, more than ten (10) feet away from pavement, or under driveways
         when directed by the Engineer.
         Lifting holes are allowed for storm sewer pipe sections except for pipe sections that have
         been specified to be in accordance with ASTM C361, Standard Specification for Reinforced
         Concrete Low Head Pressure Pipe. The Contractor shall plug all lifting holes with
         expandable plugs or non-shrink grout.
         Manufactured pipe bends shall meet the same ASTM requirements as the pipe material
         from which they are manufactured.
      2. Reinforced Concrete Pipe (RCP)
         a. RCP Certification
            All RCP shall be manufactured by a plant certified under the American Concrete Pipe
            Association’s (ACPA) “Quality Cast” Plant Certification Program. All RCP delivered to
            the jobsite shall be stamped with the “Q-Cast” certification stamp. Visual inspections
            for defects shall continue to take place on the site.
         b. Circular RCP
            Reinforced concrete circular pipe, fittings, and outlet structures with an inside
            diameter less than or equal to thirty (30) inches shall meet the requirements for Class

Reinforced concrete circular pipe, fittings, and outlet structures with an inside diameter greater than thirty (30) inches shall meet the requirements indicated in the Contract Documents, or shall meet the requirements for Class III, Wall B in accordance with ASTM C76, Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe; ASTM C361, Standard Specification for Reinforced Concrete Low Head Pressure Pipe; or D-Load pipe in accordance with ASTM C655, Standard Specification for Reinforced Concrete D Load Culvert, Storm Drain, and Sewer Pipe.

c. Arch RCP

Reinforced concrete arch pipe, fittings, and outlet structures shall meet the requirements for Class A-III pipe in accordance with ASTM C506, Standard Specification for Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe.

d. Elliptical RCP

Reinforced concrete elliptical pipe, fittings, and outlet structures shall meet the requirements for Class HE-III or Class VE-III in accordance with ASTM C507, Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe.

e. Precast Reinforced Concrete Box

Reinforced concrete box sections shall be in accordance with ASTM C1433, Standard Specification for Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers.

f. RCP Joints

RCP joints shall be sealed with either a bitumastic material in accordance with ASTM C990, Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants, or gaskets in accordance with ASTM C443, Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.

When using bitumastic material to seal the joints, an external sealing wrap meeting the requirements for Type II or Type III in accordance with ASTM C877, Standard Specification for External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections, shall be applied to each joint after pipe installation. Pipe shall be installed within four (4) hours after application of bitumastic material. The minimum quantity of bitumastic material to be applied shall be in accordance with Table 702.01.
Table 702.01
Mastic Requirements for Concrete Pipe Joints

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>12&quot;</td>
<td>1.75</td>
<td>28</td>
<td>36&quot;</td>
<td>18.7</td>
<td>2.5</td>
</tr>
<tr>
<td>15&quot;</td>
<td>2.77</td>
<td>18</td>
<td>42&quot;</td>
<td>24.37</td>
<td>2</td>
</tr>
<tr>
<td>18&quot;</td>
<td>4.12</td>
<td>12</td>
<td>48&quot;</td>
<td>29.63</td>
<td>1.5</td>
</tr>
<tr>
<td>21&quot;</td>
<td>5.98</td>
<td>8</td>
<td>54&quot;</td>
<td>45.02</td>
<td>1</td>
</tr>
<tr>
<td>24&quot;</td>
<td>7.83</td>
<td>6</td>
<td>60&quot;</td>
<td>59.13</td>
<td>.75</td>
</tr>
<tr>
<td>27&quot;</td>
<td>10.76</td>
<td>4.5</td>
<td>66&quot;</td>
<td>74.26</td>
<td>.66</td>
</tr>
<tr>
<td>30&quot;</td>
<td>13.7</td>
<td>3.5</td>
<td>72&quot;</td>
<td>91.6</td>
<td>.5</td>
</tr>
</tbody>
</table>

When “o-ring” or water tight joints are indicated in the Contract Documents, the joints shall be in accordance with ASTM C361, Standard Specification for Reinforced Concrete Low Head Pressure Pipe. The joint shall be designed to limit the gasket deformation for not less than fifteen (15) percent or more than fifty-five (55) percent deformation.

Material for RCP pipe couplers shall be in accordance with ASTM A325, Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength; and shall be galvanized in accordance with ASTM A123, Standard Specification for Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products.

g. Joint Mortar

Pipe joint mortar shall consist of one part Portland cement and two parts sand. The Portland cement shall conform to the requirements for Type II Cement in accordance with ASTM C150, Standard Specification for Portland Cement, including Table 1, Table 2, and Table 4. The sand shall be in accordance with ASTM C144, Standard Specification for Aggregate for Masonry Mortar.

3. Ductile Iron Pipe (DIP)

DIP shall be in accordance with ASTM A746, Standard Specification for Ductile Iron Gravity Sewer Pipe; or ANSI/AWWA C151/A21.51, Ductile-Iron Pipe, Centrifugally Cast. DIP shall have an exterior coating in accordance with ANSI/AWWA C151/A21.51, Ductile-Iron Pipe, Centrifugally Cast. DIP shall be wrapped in polyethylene encasement in accordance with ANSI/AWWA C105/A21.5, Polyethylene Encasement for Ductile-Iron Pipe Systems.

Joints for DIP shall be in accordance with ANSI/AWWA C111/A21.11, Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

C. Inlets

1. Cast-In-Place Inlets

Cast-in-place inlets shall be in accordance with the Contract Documents and the applicable Standard Plates. The Contractor shall use a gutter depression template to construct inlet openings in accordance with the Standard Plates.
2. **Precast Inlet Tops**

Precast inlet tops shall be in accordance with the Contract Documents and the applicable Standard Plates. Penetrating concrete sealer shall be applied to the precast inlet tops at the manufacturer’s facility.

3. **Area Inlets**

Area inlets shall be in accordance with the Contract Documents and the applicable Standard Plates.

4. **Grate Inlets and Frames**

Grate inlets shall be in accordance with the Contract Documents and the applicable Standard Plates. Metal frames and grates shall be in accordance with ASTM A48, Standard Specification for Gray Iron Castings.

D. **Storm Sewer Manholes**

1. **Storm Sewer Manhole Joints**

Storm sewer manhole joints shall be sealed with either a bitumastic material in accordance with ASTM C990, Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants; or gaskets conforming to ASTM C443, Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.

When using bitumastic material to seal the joints, an external sealing wrap meeting the requirements for Type II or Type III in accordance with ASTM C877, Standard Specification for External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections, shall be applied to each joint after manhole installation. Manhole sections shall be installed within four (4) hours after application of bitumastic material.

2. **Storm Sewer Manhole Lifting Holes**

Lifting holes are allowed for storm sewer manhole sections except for manhole sections that have been specified to be in accordance with ASTM C361, Standard Specification for Reinforced Concrete Low Head Pressure Pipe. The Contractor shall plug all lifting holes with expandable plugs or non-shrink grout.

E. **External Sealing Wrap**

When using bitumastic material to seal the joints, an external sealing wrap meeting the requirements for Type II or Type III in accordance with ASTM C877, Standard Specification for External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections, shall be applied to each joint after pipe and/or manhole section installation.

F. **Appurtenances**

1. **Flared End Sections**

Flared end sections shall be integral units that connect as a continuation of the storm sewer or culvert pipe. RCP flared end sections and their foundations shall be in accordance with Standard Plate 702-12. RCP flared end sections shall include pipe couplers in accordance with Standard Plate 700-04.

2. **Bar Grates**

Bar grates for RCP flared end sections shall be in accordance with Standard Plate 702-12.
Reinforcing steel shall be deformed steel bars in accordance with ASTM A615, Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement; or ASTM A996, Standard Specification for Rail Steel and Axle Steel Deformed Bars for Concrete Reinforcement. Do not use Grade 50 or Grade 60 rail steel bars for tie bars bent or straightened during construction. For construction requiring bent bars, use Grade 40 tie bars in accordance with ASTM A615, Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement. Galvanize the bar grates in accordance with ASTM A123, Standard Specification for Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products.

702.03 Construction Requirements

A. General

Refer to Section 700.03 for general construction requirements, in addition to the following requirements. Storm sewer pipe to be removed and relayed shall be removed in a manner to prevent damage, inspected for defects, and reinstalled in accordance with Section 700.03.

Construct concrete cradles, collars, and manhole taps at the locations indicated in the Contract Documents or as directed by the Engineer, and in accordance with Standard Plate 700-01.

B. Additional Requirements

1. Reinforced Concrete Pipe (RCP) (Circular, Arch, Elliptical, RC Box)

   Install RCP in accordance with ASTM C1479, Standard Practice for Installation of Precast Concrete Sewer, Storm Drain, and Culvert Pipe Using Standard Installations. Place elliptical and elliptically reinforced pipes with the manufacturer's top of pipe mark within five (5) degrees of the longitudinal axis of the pipe.

2. Ductile Iron Pipe (DIP)

   Install DIP in accordance with AWWA C600, Installation of Ductile-Iron Water Mains and Their Appurtenances. Clean joints prior to gasket installation. Install DIP with loose polyethylene encasement. Replace polyethylene encasement that is torn or damaged at no additional cost to the City.

3. Pipe Couplers

   Install pipe couplers in accordance with Standard Plate 700-04.

4. Pipe Bends

   Install precast concrete or prefabricated metal pipe bends in accordance with the manufacturer’s recommendations.

5. Flared End Sections

   Install pipe couplers on flared end sections in accordance with Standard Plate 700-04.

C. Inlets

Construct inlets complete with all rings, covers, frames, and grates.

1. Curb Inlets

   Construct curb inlets at locations indicated in the Contract Documents and in accordance with the applicable Standard Plates.
2. **Area Inlets**
   Construct area inlets at locations indicated in the Contract Documents and in accordance with the applicable Standard Plates.

3. **Grate Inlets**
   Construct grate inlets at locations indicated in the Contract Documents and in accordance with the applicable Standard Plates.

4. **Remove and Replace Inlet Top**
   Remove inlet tops at locations indicated in the Contract Documents and in accordance with Section 100. Replace inlet tops in accordance with the applicable Standard Plates.

5. **Remove and Replace Curb Inlet Throat**
   Remove curb inlet throats at locations indicated in the Contract Documents and in accordance with Section 100. Replace curb inlet throats in accordance with the applicable Standard Plates and Section 500.

6. **Reconstruct Inlet Walls**
   Remove inlet walls at locations indicated in the Contract Documents and in accordance with Section 100. Reconstruct inlet walls in accordance with the applicable Standard Plates.

D. **External Sealing Wrap**
   Install external sealing wrap on all pipe and manhole joints using bitumastic material in accordance with the manufacturer’s recommendations. External sealing wrap installed during new construction is subsidiary to items for which the Contract provides direct payment.

702.04 **Acceptance**
   Before installing pipe, inspect the pipe for cracks or other damage. Damaged pipe and manhole sections include any pipe or manhole section with a defect that materially affects the pipe’s or manhole’s ability to function as intended. Damaged pipe and manhole sections shall not be installed and shall be removed from the site and replaced at the Contractor’s expense.

   The Engineer shall observe the work to check for compliance with the Contract Documents. Concrete shall be constructed to the minimum compressive strength requirements identified in the Contract Documents. The Engineer shall verify the compressive strength of the concrete in accordance with the City of Omaha Materials and Testing Manual for Public Works Construction.

   Pipe, manholes, and inlets that fail to meet the acceptance requirements shall be removed and replaced at the Contractor’s expense.

A. **Storm Sewer Pipe Testing and Acceptance**
   At the discretion of the Engineer, the Contractor shall remove and relay storm sewer pipe not in conformance with tolerances in Section 700. The Contractor shall be responsible for replacing pipe damaged during the removal and relaying operations at no additional cost to the City.

   For storm sewer pipes constructed with joints meeting the requirements of ASTM C361, Standard Specification for Reinforced Concrete Low Head Pressure Pipe, each joint shall be tested in accordance with ASTM C1103, Standard Practice for Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines.
CCTV acceptance testing for storm sewer pipes shall also be in accordance with Section 706. CCTV inspections for storm sewer acceptance testing shall be performed after paving, unless otherwise indicated in the Contract Documents or as directed by the Engineer.

B. Storm Sewer Manhole and Inlet Testing and Acceptance

Acceptance testing for manholes and inlets shall consist of visual inspection to check for structural defects, obstructions, and debris.

For storm sewer manholes with joints meeting the requirements of ASTM C361, Standard Specification for Reinforced Concrete Low Head Pressure Pipe, acceptance testing shall consist of vacuum air testing in accordance with ASTM C1244, Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill. Manhole acceptance testing shall be performed after backfill operations. Perform testing on manholes prior to construction of pavement, sidewalk, or other improvements located above the manholes. Notify the Engineer a minimum of twenty-four (24) hours before scheduling testing. Do not perform any acceptance testing without the Engineer present. The Contractor is responsible for any damage to public or private property resulting from acceptance testing or by failure of pipe plugs. Adjustment riser sections shall not be included in the vacuum test.

702.05 Measurement and Payment

The Engineer shall measure removing and relaying storm sewer pipe for payment by the linear feet of the size of storm sewer pipe removed, reinstalled, backfilled, and accepted.

The Engineer shall measure storm sewer pipe for payment by the linear feet of the size and type of storm sewer pipe supplied, constructed, bedded, backfilled, and accepted. The Engineer shall conduct measurements along the horizontal surveyed centerline of all storm sewer pipes from center to center of structure for all inlets and manholes. The Engineer shall measure connections to junction boxes and all other structures at the inside face of the structure.

The Engineer shall measure pipe culverts for payment by the linear feet of the size and type of pipe culvert supplied, constructed, bedded, backfilled, and accepted. The Engineer shall conduct measurements along the horizontal surveyed centerline of the pipe culvert from the start of the pipe culvert to the end of the pipe culvert, excluding any wing walls or other inlet or outlet structures.

The Engineer shall measure concrete collars for payment by the size of each concrete collar constructed and accepted.

The Engineer shall measure concrete cradles for payment by the size of each concrete cradle constructed and accepted.

The Engineer shall measure pipe bends for payment by the size and type of each bend manufactured and accepted.

The Engineer shall measure storm sewer taps for payment by the size of each tap constructed and accepted.

The Engineer shall measure flared-end sections for payment by the size and type of each flared-end section constructed and accepted. Pipe couplers and foundations shall be subsidiary to the construction of each flared-end section.

The Engineer shall measure pipe plugs for payment by the size and type of each pipe plug constructed and accepted.
The Engineer shall measure storm manholes for payment by the vertical feet measured from the top of the manhole ring to the outlet pipe invert for the size of storm sewer manhole constructed and accepted. The Engineer shall round measurements to the nearest one-tenth (0.1) foot. Final elevation adjustment shall be incidental to manhole construction.

The Engineer shall measure storm sewer manhole adjustments for payment by each existing storm sewer manhole adjusted and accepted.

The Engineer shall measure storm sewer manhole reconstructions for payment by the vertical feet of existing storm sewer manhole reconstructed and accepted. The Engineer shall round measurements to the nearest one-tenth (0.1) foot.

The Engineer shall measure storm sewer inlets for payment by the size and type of each storm sewer inlet constructed and accepted.

The Engineer shall measure removal and replacement of storm sewer inlet tops for payment by the size and type of each storm sewer inlet top removed, replaced, constructed, and accepted.

The Engineer shall measure removal and replacement of storm sewer curb inlet throats for payment by each storm sewer curb inlet throat removed, constructed, and accepted.

The Engineer shall measure reconstruction of storm sewer inlet walls for payment by the type of each storm sewer inlet wall removed, constructed, and accepted.

The Engineer shall measure external frame seals on storm sewer manholes for payment by each external frame seal supplied, installed, and accepted.

Payment shall be made under the following unless otherwise indicated in the Contract Documents. The Contract Price shall be full compensation for excavation, trench protection, de-watering, pipe and manhole installation, pipe fittings, bitumastic material, external sealing wraps, gaskets, pipe and joint mortar, bedding, backfilling, compaction, exposing locations for testing, and clean-up and disposal of excess material; all acceptance testing and all testing equipment; and for all labor, materials, equipment, tools, and all incidentals necessary to complete the work.
<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remove and Relay __” Storm Sewer Pipe</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Construct __” RCP, Class III</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Construct __” RCP, D(0.01) = 1,350</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Construct __” RCP, Class IV</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Construct __” RCP, D(0.01) = 2,000</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Construct __” RCP, Class V</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Construct __” RCP, D(0.01) = 3,000</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Construct __” Equivalent HERCP, Class III</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Construct __” Equivalent HERCP, Class IV</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Construct __” Equivalent Arch Pipe, Class III</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Construct __” Equivalent Arch Pipe, Class IV</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Construct __” DIP</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Construct __” Type ___ Pipe Culvert</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Construct __” Storm Sewer Concrete Collar</td>
<td>Each</td>
</tr>
<tr>
<td>Construct __” Storm Sewer Concrete Cradle</td>
<td>Each</td>
</tr>
<tr>
<td>Construct __” RCP Bend</td>
<td>Each</td>
</tr>
<tr>
<td>Construct __” Storm Sewer Tap</td>
<td>Each</td>
</tr>
<tr>
<td>Construct __” RC Flared End Section</td>
<td>Each</td>
</tr>
<tr>
<td>Construct __” RC Flared End Section w/Bar Grate</td>
<td>Each</td>
</tr>
<tr>
<td>Construct __” Storm Sewer Pipe Plug</td>
<td>Each</td>
</tr>
<tr>
<td>Construct __” I.D. Storm Manhole</td>
<td>Vertical Foot</td>
</tr>
<tr>
<td>Adjust Storm Sewer Manhole to Grade</td>
<td>Each</td>
</tr>
<tr>
<td>Reconstruct Storm Sewer Manhole</td>
<td>Vertical Foot</td>
</tr>
<tr>
<td>Construct Curb Inlet – Type ___</td>
<td>Each</td>
</tr>
<tr>
<td>Construct Grate Inlet – Type ___</td>
<td>Each</td>
</tr>
<tr>
<td>Construct Area Inlet – Type ___</td>
<td>Each</td>
</tr>
<tr>
<td>Remove and Replace ___ Inlet Top – Type ___</td>
<td>Each</td>
</tr>
<tr>
<td>Remove and Replace Curb Inlet Throat</td>
<td>Each</td>
</tr>
<tr>
<td>Reconstruct ___ Inlet Walls</td>
<td>Each</td>
</tr>
<tr>
<td>Install External Frame Seal on Storm Sewer Manhole</td>
<td>Each</td>
</tr>
</tbody>
</table>
703 Sanitary Sewer Pipe and Manholes

703.01 General
   A. Description
      This work includes furnishing and constructing sanitary sewers, manholes, and appurtenances along the lines and grades indicated in the Contract Documents or as directed by the Engineer.

   B. Submittal Requirements
      Refer to Section 700.01 B for submittal requirements.

703.02 Material Requirements
   A. General
      Refer to Section 700.02 for general material requirements, in addition to the following requirements.

      Portland cement for sanitary and combined sewer applications shall conform to the requirements for Type II Cement in accordance with ASTM C150, Specification for Portland Cement, including Table 2 (Equivalent alkalis requirements only) and Table 3.

   B. Sanitary Sewer Pipe and Fittings
      1. General
         Sanitary sewer pipe constructed within the right-of-way or easement shall be plastic lined reinforced concrete pipe (RCP), vitrified clay pipe (VCP), solid wall polyvinyl chloride (PVC) pipe, ductile iron pipe (DIP), or centrifugally cast fiberglass polymer mortar (fiberglass) pipe.

      2. Plastic Lined Reinforced Concrete Pipe (RCP)
         a. RCP Certification
            All RCP shall be manufactured by a plant certified under the American Concrete Pipe Association’s (ACPA) “Quality Cast” Plant Certification Program. All RCP delivered to the jobsite shall be stamped with the “Q-Cast” certification stamp. Visual inspections for defects shall continue to take place on the site.

         b. Sanitary Sewer RCP
            Lifting holes shall not be used for sanitary sewer RCP.

            Sanitary sewer RCP shall be in accordance with ASTM C361, Standard Specification for Reinforced Concrete Low Head Pressure Pipe.

         c. RCP Joints and Gaskets
            Joints for sanitary sewer RCP shall use a rubber gasket in accordance with ASTM C443, Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets, or a confined “o-ring” gasket in accordance with ASTM C361, Standard Specification for Reinforced Concrete Low Head Pressure Pipe. The joint shall be designed to limit the gasket deformation for not less than fifteen (15) percent or more than fifty-five (55) percent deformation.

         d. Plastic Lining for RCP
            The RCP shall be completely lined with a seamless liner. All liner plates furnished shall be composed of chemically inert synthetic resin, pigments and plasticizers (PVC only)
suitably compounded and processed; formed under pressure into permanently flexible sheets; and not less than sixty-five thousandth (0.065-in) inch thick. Polyvinyl chloride (PVC) or high density polyethylene (HDPE) resin shall constitute not less than ninety-nine (99) percent by weight of the resin used in the formulation. Copolymer resins shall not be permitted.

3. **Vitrified Clay Pipe (VCP)**
   
   a. **General**
   

   The bearing strength tests shall be conducted in accordance with ASTM C301, Standard Test Methods for Vitrified Clay Pipe.

   b. **VCP Joints and Gaskets**
   
   Joints for VCP shall be in accordance with ASTM C425, Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings. All clay pipe joints shall consist of two sealing components, where one component is bonded to the outside of the clay spigot and the other component is bonded to the inside of the clay bell. Polyvinyl chloride (PVC) coupling collars or wrapping of the joint exterior with any material shall not be allowed.

4. **Polyvinyl Chloride (PVC) Pipe**
   
   a. **General**
   
   Additives and fillers, including but not limited to stabilizers, antioxidants, lubricants, colorants, etc., shall not exceed ten (10) parts by weight per one-hundred (100) of PVC resin in the compound.

   (i) **Solid Wall PVC Pipe**

   Solid wall PVC pipe shall be in accordance with ASTM D3034, Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings. Solid wall PVC pipe and fittings having an inside diameter of less than or equal to six (6) inches shall be in accordance with SDR 23.5. Solid wall PVC pipe and fittings having an inside diameter greater than or equal to eight (8) inches shall be in accordance with SDR 26.

   Solid wall PVC pipe and fittings having an inside diameter of eighteen (18) inches and greater shall be in accordance with ASTM F679, Standard Specification for Poly(Vinyl Chloride) (PVC) Large Diameter Plastic Gravity Sewer Pipe and Fittings.

   b. **PVC Joints and Gaskets**

5. Ductile Iron Pipe (DIP)
   a. General
      DIP shall be in accordance with ASTM A746, Standard Specification for Ductile Iron Gravity Sewer Pipe; or ANSI/AWWA C151/A21.51, Ductile-Iron Pipe, Centrifugally Cast.

      DIP shall be wrapped in polyethylene encasement in accordance with ANSI/AWWA C105/A21.5, Polyethylene Encasement for Ductile-Iron Pipe Systems.

   b. Interior Lining and Exterior Coating
      DIP used for sanitary sewer shall have an interior cement mortar lining in accordance with ANSI/AWWA C104/A21.4, Cement-Mortar Lining for Ductile-Iron Pipe and Fittings; or an amine cured novalac epoxy containing at least twenty percent (20%) by volume of ceramic quartz pigment, such as Protecto 401, Permox CTF or equal.

      DIP shall have an exterior coating in accordance with ANSI/AWWA C151/A21.51, Ductile-Iron Pipe, Centrifugally Cast.

   c. DIP Joints and Gaskets
      Joints for DIP shall be in accordance with ANSI/AWWA C111/A21.11, Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

6. Fiberglass Reinforced Polymer Mortar Pipe (Fiberglass)
   a. General
      Fiberglass pipe shall be in accordance with ASTM D3262, Standard Specification for "Fiberglass" (Glass Fiber Reinforced Thermosetting Resin) Sewer Pipe. Fiberglass pipe fittings shall be in accordance with ASTM D3840, Standard Specification for Fiberglass (Glass Fiber Reinforced Thermosetting Resin) Pipe Fittings for Nonpressure Applications.

   b. Fiberglass Joints and Gaskets
      Joints for fiberglass pipe shall be in accordance with ASTM D4161, Standard Specification for Fiberglass (Glass Fiber Reinforced Thermosetting Resin) Pipe Joints Using Flexible Elastomeric Seals.

C. Sanitary Sewer Manholes
   1. Sanitary Sewer Manhole Joints
      Joints for sanitary sewer manholes shall use a rubber gasket in accordance with ASTM C443, Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets, or a confined “o-ring” gasket in accordance with ASTM C361, Standard Specification for Reinforced Concrete Low Head Pressure Pipe.

   2. Sanitary Sewer Manhole Lifting Hooks
      Inserts for lifting hooks shall be embedded in the wall of the manhole barrel sections. Lifting holes shall not be used.

   3. Sanitary Sewer Manhole Pipe Connections
      Connections shall be in accordance with ASTM C923, Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals.
D. Appurtenances

1. Wyes and Tees

Wyes and tees shall conform to the specifications of the sewer pipe material used. Wyes and tees used in sanitary sewer systems to connect to private sewer laterals shall be a minimum diameter of six (6) inches.

2. Pipe Couplings

a. Flexible Transition Couplings

Flexible transition couplings with stainless steel shields shall be used when joining pipes made of different materials, pipes of different sizes, new to existing pipes, or repairing existing pipes. Flexible transition couplings shall be in accordance with ASTM C1173, Standard Specification for Flexible Transition Couplings for Underground Piping Systems. Shields, shear rings, clamps, and tightening bands shall be in accordance with ASTM A240, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.

b. RCP Couplers

Material for RCP pipe couplers shall be in accordance with ASTM A325, Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength; and shall be galvanized in accordance with ASTM A123, Standard Specification for Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products.

3. Cleanouts

Cleanout pipes, bends, fittings, frames, and lids shall be solid wall PVC meeting the material requirements of Section 703.02 B.4. Concrete for collars shall be in accordance with Section 500.

4. Sanitary Service Risers

Sanitary service riser pipes, bends, and fittings shall be solid wall PVC meeting the material requirements of Section 703.02 B.4. Concrete thrust blocks shall be in accordance with Section 500.

E. Sampling Manholes

Sampling manholes shall be in accordance with Section 703.02 C and Standard Plate 708-01. Joints for sampling manholes shall be a confined “o-ring” gasket in accordance with ASTM C361, Standard Specification for Reinforced Concrete Low Head Pressure Pipe.

703.03 Construction Requirements

A. General

Refer to Section 700.03 for general construction requirements, in addition to the following requirements. All sanitary sewer pipe crossings over water mains shall meet the requirements of the most current edition of the Recommended Standards for Wastewater Facilities (Ten State Standards).

The Contractor shall install a watertight plug to prevent foreign matter from entering the pipe during periods of inactivity.

Construct wyes and tees at the locations indicated in the Contract Documents or as directed by the Engineer, and in accordance with the requirements for installation of the adjacent pipe.
Wyes and tees used to connect to private sewer laterals shall be a minimum diameter of six (6) inches.

Construct cleanouts at the locations indicated in the Contract Documents or as directed by the Engineer, and in accordance with the City of Omaha’s Plumbing Code and Standard Plate 703-04.

Construct sanitary service risers at the locations indicated in the Contract Documents or as directed by the Engineer, and in accordance with Standard Plate 703-01. Constructing sanitary service risers shall include, but not be limited to, constructing the vertical portion of the sanitary service pipe from the wye, tee, or manhole tap at the main, to the horizontal portion of the sanitary service pipe. Construction of the concrete thrust block(s), bends, and couplers shall be considered incidental to items for which the Contract provides direct payment.

Construct sanitary service connections at the locations indicated in the Contract Documents or as directed by the Engineer. Construction of couplers shall be considered incidental to items for which the Contract provides direct payment.

Reconnect existing sanitary services at the locations indicated in the Contract Documents or as directed by the Engineer. Reconnecting existing sanitary services shall include, but not be limited to, constructing the horizontal portion of sanitary service pipe from the wye, tee, or manhole tap at the main to the existing sanitary service pipe or property line. Unless otherwise indicated in the Contract Documents, the replaced pipe shall be of similar size and material type as the surrounding existing pipes. Construction of couplers shall be considered incidental to items for which the Contract provides direct payment.

Repair existing sanitary services at the locations indicated in the Contract Documents or as directed by the Engineer. Repairing existing sanitary services shall include, but not be limited to, constructing the horizontal portion of sanitary service pipe from the existing sanitary service pipe to the existing sanitary service pipe or property line. Unless otherwise indicated in the Contract Documents, the replaced pipe shall be of similar size and material type as the surrounding existing pipes. Construction of couplers shall be considered incidental to items for which the Contract provides direct payment.

Construct concrete cradles, collars, and manhole taps at the locations indicated in the Contract Documents or as directed by the Engineer, and in accordance with Standard Plate 700-01. Unless otherwise directed by the Engineer, taps to sanitary sewer pipes shall not be allowed unless also constructing a wye, tee, or manhole at the proposed tap location.

B. Additional Requirements

1. **Reinforced Concrete Pipe (RCP) (Circular, Arch, Elliptical)**
   
   Install RCP in accordance with ASTM C1479, Standard Practice for Installation of Precast Concrete Sewer, Storm Drain, and Culvert Pipe Using Standard Installations. Place elliptical and elliptically reinforced pipes with the manufacturer's top of pipe mark within five (5) degrees of the longitudinal axis of the pipe. Pipe couplers shall be in accordance with Standard Plate 700-04.

2. **Vitrified Clay Pipe (VCP)**
   
   Install VCP in accordance with ASTM C12, Standard Practice for Installing Vitrified Clay Pipe Lines.
3. **Polyvinyl Chloride (PVC) Pipe**

   Install PVC pipe in accordance with ASTM D2321, Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity Flow Applications.

   All PVC pipe stored onsite for more than fourteen (14) days shall be covered to protect from ultraviolet (UV) degradation. Material(s) used for covering PVC pipe shall be in accordance with pipe manufacturer’s recommendations.

4. **Ductile Iron Pipe (DIP)**

   Install DIP in accordance with AWWA C600, Installation of Ductile-Iron Water Mains and Their Appurtenances. Install DIP to ensure protection of the interior lining per the manufacturer’s recommendations. Clean joints prior to gasket installation. Install DIP with loose polyethylene encasement. Replace polyethylene encasement that is torn or damaged at no additional cost to the City.

5. **Fiberglass Reinforced Polymer Mortar Pipe (Fiberglass)**

   Install fiberglass pipe in accordance with ASTM D3839, Standard Guide for Underground Installation of "Fiberglass" (Glass-Fiber Reinforced Thermosetting-Resin) Pipe.

C. **Plastic Lining Installation in RCP**

1. **Quality Assurance**

   The Contractor shall provide the services of a qualified representative of the lining system manufacturer to review the project, materials, manufacturing process, and samples of the final pipe product; to certify workers welding the lining; and to observe at least two (2) days of welding of lining joints. The manufacturer’s representative shall be available for consultation during installation of the lining system and shall inspect the completed installation.

2. **Field Jointing of Liner**

   RCP joints shall be tested and accepted prior to welding of the liner joints.

   All welding of liner joints shall be prepared, welded, and tested in accordance with the lining manufacturer’s requirements.

   No coating of any kind shall be applied over any joint, corner, or welding strip.

3. **Protection and Repair of Liner**

   All necessary measures and precautions shall be taken to prevent damage to the liner from equipment and materials used to perform the work. Any damage to the installed liner shall be repaired by the Contractor in accordance with the manufacturer’s recommendations at no additional cost to the City.

D. **Sanitary Sewer Manholes**

   Construct drop manhole connections at the locations indicated in the Contract Documents or as directed by the Engineer. Drop manholes shall be constructed in accordance with Standard Plate 703-03.

E. **Sampling Manholes**

   Sampling manholes shall be constructed in accordance with Standard Plate 708-01.
F. Post-Paving Sewer Cleaning

Upon completion of the paving the Contractor shall clean all sanitary sewer pipes eight (8) inch and larger within the limits of paving in accordance with Section 706. The sanitary sewer shall be cleaned utilizing a sewer jet, and any accumulated material shall be removed and disposed of in accordance with Section 100.

703.04 Acceptance

Before installing pipe, inspect the pipe for cracks or other damage. Damaged pipe and manhole sections include any pipe or manhole section with a defect that materially affects the pipe’s or manhole’s ability to function as intended. Damaged pipe and manhole sections shall not be installed and shall be removed from the site and replaced at the Contractor’s expense.

The Engineer shall observe the work to check for compliance with the Contract Documents. Concrete shall be constructed to the minimum compressive strength requirements identified in the Contract Documents. The Engineer shall verify the compressive strength of the concrete in accordance with the City of Omaha Materials and Testing Manual for Public Works Construction.

A. Sanitary Sewer Pipe Testing and Acceptance

Acceptance testing for sanitary sewer lines between manholes shall consist of one or more of the following methods: television inspection, visual inspection, low-pressure air testing, infiltration/exfiltration testing, and deflection testing, depending on the type of pipe as defined below. Do not permit live wastewater flow in the sanitary sewer until all testing is completed and found acceptable, unless otherwise indicated in the Contract Documents. Perform pipe testing after completing backfill operations but before constructing surface improvements. The Contractor shall notify the Engineer a minimum of twenty-four (24) hours before scheduling testing. The Contractor shall not perform any acceptance testing without the Engineer present.

Remove any soil, debris, or other unwanted material from the sewer line upon completion of installation and before commencing acceptance testing. All pipe installation(s) with failing tests shall be located, corrected, and retested at no additional cost to the City. Damaged pipe shall be removed and replaced at the Contractor’s expense.

Alignment testing shall be in accordance with the Nebraska Department of Environmental Quality’s Title 123 Rules and Regulations for the Design, Operation and Maintenance of Wastewater Works, current edition.

CCTV inspections for sanitary sewer acceptance testing, conducted in accordance with Section 706, shall be performed before paving and at least thirty (30) days after backfilling, unless otherwise indicated in the Contract Documents or as directed by the Engineer.

1. RCP
   a. Pipe

   For sanitary sewer pipes constructed with joints meeting the requirements of ASTM C361, Standard Specification for Reinforced Concrete Low Head Pressure Pipe, each joint shall be tested, before welding plastic lining joints, in accordance with ASTM C1103, Standard Practice for Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines.

   For sanitary sewer pipes constructed with joints meeting the requirements of ASTM C443, Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets, each segment shall be tested, before welding plastic lining joints, in
accordance with C969, Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines.

CCTV acceptance testing for sanitary sewer pipes shall be in accordance with Section 706.

b. Plastic Lining

The Contractor shall provide adequate ventilation, access, barricades and/or traffic control devices, and shall be responsible for opening and closing entrances and exits necessary for all testing. The Contractor shall notify the Engineer a minimum of twenty-four (24) hours before scheduling testing. The Contractor shall not perform any acceptance testing without the Engineer present.

All welds of the plastic lining shall be tested in accordance with the manufacturer’s recommendations. All areas of liner failing to meet the field test shall be repaired in accordance with the manufacturer’s recommendations and retested.

2. VCP

Acceptance testing for VCP shall be in accordance with ASTM C828, Standard Test Method for Low Pressure Air Test of Vitrified Clay Pipe Lines.

CCTV acceptance testing for sanitary sewer pipes shall be in accordance with Section 706.

3. PVC

Acceptance testing for PVC pipe shall be in accordance with ASTM F1417, Standard Practice for Installation Acceptance of Plastic Non-pressure Sewer Lines Using Low Pressure Air.

All PVC sanitary sewer pipe shall be tested for deflection. Deflection testing is required to verify compliance with the maximum allowable ring deflection of five (5) percent on all flexible pipe installations. Deflection testing shall be completed a minimum of thirty (30) days after completion of the backfill over the pipe.

Perform deflection testing using a deflectometer that produces a continuous record of pipe deflection, such as a laser profiler, or by pulling a mandrel through the pipeline. Do not apply any excessive forces when pulling the deflectometer or mandrel that may damage the pipe or erroneously indicate that deflection was within acceptable limits.

Mandrels shall be fabricated of steel with pull rings at each end. Mandrels shall be rigid, nonadjustable, have an odd-number of legs (nine (9) minimum), and have an effective length not less than its nominal diameter. The diameter of the mandrel shall be ninety-five (95) percent of the actual inside diameter for the size of pipe constructed.

The maximum allowable ring deflection of the pipeline after installation shall be five (5) percent. If the mandrel fails to pass through the pipe, the pipe shall be deemed unacceptable. Uncover any unacceptable pipe and reinstall in accordance with Section 703.03. Excavation, removal, replacement, and/or re-testing unacceptable pipe shall be completed at no additional cost to the City.

CCTV acceptance testing for sanitary sewer pipes shall be in accordance with Section 706.

4. DIP

Acceptance testing for DIP shall be in accordance with the manufacturer’s recommendations, and AWWA C600, Installation of Ductile-Iron Water Mains and Their Appurtenances.
CCTV acceptance testing for sanitary sewer pipes shall be in accordance with Section 706.

5. **Fiberglass**

   Acceptance testing for fiberglass pipe shall be in accordance with the manufacturer’s recommendations, and ASTM D3839, Standard Practice for Underground Installation of “Fiberglass” (Glass-Fiber Reinforced Thermo-setting-Resin) Pipe.

   Mandrel testing for fiberglass pipe shall be the same as for PVC pipe in 703.04.A.3.

   CCTV acceptance testing for sanitary sewer pipes shall be in accordance with Section 706.

B. **Sanitary Manhole Testing and Acceptance**

   Acceptance testing for sanitary manholes shall consist of vacuum air testing in accordance with ASTM C1244, Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill. At the Contractor’s discretion, sanitary manhole acceptance testing may be performed after backfill operations. Perform testing on sanitary manholes prior to construction of pavement, sidewalk, or other improvements located above the manholes. The Contractor shall notify the Engineer a minimum of twenty-four (24) hours before scheduling testing. The Contractor shall not perform any acceptance testing without the Engineer present. The Contractor is responsible for any damage to public or private property resulting from acceptance testing or by failure of pipe plugs. Adjustment riser sections shall not be included in the vacuum test.

   Damaged manhole sections shall be removed and replaced at no additional cost to the City. Manhole sections that fail to meet the acceptance testing requirements shall be removed replaced, and retested at no additional cost to the City.

C. **Sampling Manhole Testing and Acceptance**

   Acceptance testing for sampling manholes shall consist of visual inspection to check for structural defects, obstructions, and debris.

   For sampling manholes with joints meeting the requirements of ASTM C361, Standard Specification for Reinforced Concrete Low Head Pressure Pipe, acceptance testing shall consist of hydrostatic testing in accordance with ASTM C497, Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile. Manhole acceptance testing shall be performed after backfill operations. Perform testing on manholes prior to construction of pavement, sidewalk, or other improvements located above the manholes. Notify the Engineer a minimum of twenty-four (24) hours before scheduling testing. Do not perform any acceptance testing without the Engineer present. The Contractor is responsible for any damage to public or private property resulting from acceptance testing or by failure of pipe plugs. Adjustment riser sections shall not be included in the vacuum test.

D. **Correction Period Testing**

   Deflection testing shall be required at the end of the two (2) year correction period. Failure to complete deflection testing prior to the end of the correction period will cause the correction period to extend until the deflection testing is performed and accepted by the Engineer. Deflection tests not meeting the maximum allowable ring deflection at the end of the two (2) year correction period shall cause the pipeline to be re-inspected in accordance with Section 706. Deflection test results and CCTV inspections will be evaluated by the Engineer.
703.05 Measurement and Payment

The Engineer shall measure sanitary sewer pipe for payment by the linear feet of the size and type of sanitary sewer pipe supplied, constructed, bedded, backfilled, and accepted. The Engineer shall conduct measurements along the horizontal surveyed centerline of all sanitary sewer pipes from center to center of all manholes. The Engineer shall measure connections to all other structures at the inside face of the structure.

The Engineer shall measure sanitary sewer concrete collars for payment by the size of each collar constructed and accepted.

The Engineer shall measure sanitary sewer concrete cradles for payment by each cradle constructed and accepted.

The Engineer shall measure cleanouts for payment by the size and type of each cleanout constructed and accepted.

The Engineer shall measure wye connections for payment by the size and type of each wye connection constructed and accepted.

The Engineer shall measure tee connections for payment by the size and type of each tee connection constructed and accepted.

The Engineer shall measure sanitary sewer manhole taps for payment by the size and type of each tap constructed and accepted.

The Engineer shall measure sanitary service risers for payment by the vertical feet of service riser constructed and accepted. Construction of concrete thrust block(s), bends, and connection couplers shall be considered incidental to construction of the sanitary service riser.

The Engineer shall measure reconnecting sanitary services for payment by the linear feet of sanitary service pipe constructed and accepted. Construction of couplers shall be considered incidental to reconnecting the sanitary service.

The Engineer shall measure repairing sanitary services for payment by the linear feet of sanitary service pipe constructed and accepted. Construction of couplers shall be considered incidental to repairing the sanitary service.

The Engineer shall measure sanitary sewer pipe plugs for payment by the size and type of each sanitary sewer pipe plug constructed and accepted.

The Engineer shall measure sanitary manholes for payment by the vertical feet from the top of the manhole ring to the outlet pipe invert for the size of sanitary manhole constructed and accepted. The Engineer shall round measurements to the nearest one-tenth (0.1) foot. Final elevation adjustment shall be incidental to manhole construction.

The Engineer shall measure sanitary sewer manhole adjustments for payment by each sanitary sewer manhole adjusted and accepted.

The Engineer shall measure sanitary sewer manhole reconstructions for payment by the vertical feet of sanitary sewer manhole reconstructed and accepted. The Engineer shall round measurements to the nearest one-tenth (0.1) foot. Final elevation adjustment shall be incidental to manhole reconstruction.

The Engineer shall measure manhole drop connections for payment by the vertical feet between pipe inverts of the size of manhole drop connection constructed and accepted. The Engineer shall round measurements to the nearest one-tenth (0.1) foot.
The Engineer shall measure external frame seals on sanitary sewer manholes for payment by each external frame seal supplied, installed, and accepted.

Payment shall be made under the following unless otherwise indicated in the Contract Documents. The Contract Price shall be full compensation for excavation, trench protection, de-watering, pipe and manhole installation, pipe fittings, bitumastic material, external sealing wraps, gaskets, pipe and joint mortar, bedding, backfilling, compaction, exposing locations for testing, marking ends of service lines, and clean-up and disposal of excess material; for all acceptance testing and all testing equipment; and for furnishing all labor, materials, equipment, tools, and all incidentals necessary to complete the work.

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construct __” Lined RC Sanitary Sewer Pipe, Class ____</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Construct __” Lined RC Sanitary Sewer Pipe, D(0.01) = ____</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Construct __” DIP Sanitary Sewer Pipe</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Construct __” VCP Sanitary Sewer Pipe</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Construct __” PVC Sanitary Sewer Pipe</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Construct __” Fiberglass Sanitary Sewer Pipe</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Construct __” Sanitary Sewer Concrete Collar</td>
<td>Each</td>
</tr>
<tr>
<td>Construct __” Sanitary Sewer Concrete Cradle</td>
<td>Each</td>
</tr>
<tr>
<td>Construct __” Cleanout</td>
<td>Each</td>
</tr>
<tr>
<td>Construct __” x __” Wye</td>
<td>Each</td>
</tr>
<tr>
<td>Construct __”x ____” Tee</td>
<td>Each</td>
</tr>
<tr>
<td>Construct __” Sanitary Sewer Manhole Tap</td>
<td>Each</td>
</tr>
<tr>
<td>Construct __” Sanitary Service Riser</td>
<td>Vertical Foot</td>
</tr>
<tr>
<td>Reconnect Sanitary Service</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Repair Sanitary Service</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Construct __” Sanitary Sewer Pipe Plug</td>
<td>Each</td>
</tr>
<tr>
<td>Construct __” I.D. Sanitary Manhole</td>
<td>Vertical Foot</td>
</tr>
<tr>
<td>Construct __” I.D. Sampling Manhole</td>
<td>Vertical Foot</td>
</tr>
<tr>
<td>Adjust Sanitary Sewer Manhole to Grade</td>
<td>Each</td>
</tr>
<tr>
<td>Reconstruct Sanitary Sewer Manhole</td>
<td>Vertical Foot</td>
</tr>
<tr>
<td>Construct __” Diameter Drop Connection</td>
<td>Vertical Foot</td>
</tr>
<tr>
<td>Install External Frame Seal on Sanitary Sewer Manhole</td>
<td>Each</td>
</tr>
</tbody>
</table>
704 Trenchless Sewer Pipe Installation

704.01 General
   A. Description
      This work includes furnishing and installing storm and sanitary sewer pipe using trenchless installation methods.
   B. Submittals
      As a minimum, submit complete details of excavation protection, all materials, the proposed method of operation, and proposed equipment to the Engineer. Additional submittal requirements shall be as indicated in the Contract Documents.

704.02 Material Requirements
   A. General
      Refer to Section 700.02 for general material requirements, in addition to the following requirements.
   B. Jacking Reinforced Concrete Pipe (RCP)
      1. Storm Sewer
         Storm sewer RCP with an inside diameter less than or equal to thirty (30) inches shall meet the requirements for Class III, Wall B in accordance with ASTM C76, Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
         Storm sewer RCP with an inside diameter greater than thirty (30) inches shall meet the requirements indicated in the Contract Documents, or shall meet the requirements for Class III, Wall B in accordance with ASTM C76, Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe; ASTM C361, Standard Specification for Reinforced Concrete Low Head Pressure Pipe; or D-Load pipe in accordance with ASTM C655, Standard Specification for Reinforced Concrete D Load Culvert, Storm Drain, and Sewer Pipe.
      2. Sanitary Sewer
         Sanitary sewer RCP shall be in accordance with ASTM C361, Standard Specification for Reinforced Concrete Low Head Pressure Pipe. Sanitary sewer RCP shall be lined in accordance with Section 703.
   C. Jacking Vitrified Clay Pipe (VCP)
      VCP for trenchless applications shall be in accordance with ASTM C1208, Standard Specification for Vitrified Clay Pipe and Joints for Use in Microtunneling, Slippining, Pipe Bursting, and Tunnels.
   D. Steel Casing for Trenchless Applications
      Steel casing shall be in accordance with ASTM A139, Standard Specification for Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 and Over), with a minimum diameter as indicated in the Contract Documents. Unless otherwise noted in the Contract Documents, the minimum wall thickness shall conform to the requirements of Table 704.01. Use Grade A steel for all applications unless otherwise indicated in the Contract Documents.
Table 704.01
Steel Casing Wall Thickness

<table>
<thead>
<tr>
<th>Sewer Pipe Size</th>
<th>Casing Diameter (min.)</th>
<th>Wall Thickness (min.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>8&quot;</td>
<td>16&quot;</td>
<td>3/16&quot;</td>
</tr>
<tr>
<td>10&quot;</td>
<td>16&quot;</td>
<td>3/16&quot;</td>
</tr>
<tr>
<td>12&quot;</td>
<td>18&quot;</td>
<td>3/16&quot;</td>
</tr>
<tr>
<td>15&quot;</td>
<td>24&quot;</td>
<td>9/32&quot;</td>
</tr>
<tr>
<td>18&quot;</td>
<td>26&quot;</td>
<td>9/32&quot;</td>
</tr>
<tr>
<td>24&quot;</td>
<td>32&quot;</td>
<td>5/16&quot;</td>
</tr>
</tbody>
</table>

704.03 Construction Requirements

A. General

Refer to Section 700.03 for general construction requirements, in addition to the following requirements.

B. Trenchless Sewer Installation

Construct trenchless sewer pipes and/or casing of the size and material indicated in the Contract Documents, or as directed by the Engineer. When requested by the Engineer, submit detailed information on the superintendent and crew to be used in trenchless operation before commencing the work.

Protect existing structures, utilities, trees, or other similarly permanent objects before and during the trenchless operation. Provide positive surface drainage away from the excavated pit that avoids temporary or permanent damage to adjacent property. Repair any damage resulting from the trenchless operation at no additional cost to the City. Provide de-watering and chemical soil stabilization or grouting operations as required by field conditions or as directed by the Engineer.

Conduct trenchless operations that avoid disturbing the overlying or adjacent material. Do not use trenchless methods that use water. Remove and stockpile or dispose of materials excavated during the trenchless operation to avoid or prevent flow of material into the pipe. Install steel casing immediately following the excavation. Weld adjacent sections of steel casing together before installing. All welding shall be in accordance with AWS D2.0, Specifications for Welded Highway and Railway Bridges. Advance casing continuously with excavation. Maintain alignment, grade, and shape of the casing pipe. Installation of casing under railroad property shall be in accordance with the Contract Documents. Remove all debris from the casing pipe upon completion of the installation.

Install the sewer pipe without damaging the pipe, pipe joints, or casing. Install sewer pipe using mechanical or push-on joints to connect adjacent sections of pipe. Splicing of RCP is allowed if both portions of the splice are cut in such a manner that does not compromise the structural integrity of the RCP. Splice the pipe by exposing and welding the reinforcement steel at all junctions and miters and rebuilding the wall section to the minimum required thickness using mortar or PCC that will achieve the same hardened properties as the RCP.

The sewer pipe shall be tested and inspected after installation in accordance with Section 702.04 and/or Section 703.04.

Fill the gap between the sewer pipe and the steel casing with grout. Do not disturb the alignment or grade of the sewer pipe during grouting operations.
704.04 Acceptance

The Engineer shall observe the work to check for compliance with the Contract Documents. Acceptance of sewer pipes shall be in accordance with Section 702.04 for storm sewer pipe and Section 703.04 for sanitary sewer pipe.

704.05 Measurement and Payment

Unless otherwise indicated in the Contract Documents, the Engineer shall measure steel casings with sanitary and/or storm sewer pipes installed by tunneling for payment by the linear feet of the size and type of steel casing and sewer pipe supplied, installed, and accepted.

Unless otherwise indicated in the Contract Documents, the Engineer shall measure sanitary and/or storm sewer pipes installed by tunneling for payment by the linear feet of the size and type of sewer pipe supplied, installed, and accepted.

Payment shall be made under the following unless otherwise indicated in the Contract Documents. The Contract Price shall be full compensation for excavation, trench protection, tunneling pit(s), de-watering, clean-up and disposal of excess material; for supplying and installing casing pipe and sewer pipe; installing grout; backfilling; for all testing and testing equipment; and for furnishing all labor, materials, equipment, tools, and all incidentals necessary to complete the work.

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tunnel __” Steel Casing w/ __” Sanitary Sewer</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Tunnel __” Steel Casing w/ __” Storm Sewer</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Tunnel __” Sanitary Sewer</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Tunnel __” Storm Sewer</td>
<td>Linear Foot</td>
</tr>
</tbody>
</table>
705 Water Service Facilities

705.01 General

A. Description

This work includes relocating curb stops and/or boxes, removing and/or relocating water meters and/or water meter manholes, lowering existing water service piping, and replacing existing lead water service lines with copper pipe.

B. Submittals

Refer to Section 700.01 B for submittal requirements.

705.02 Material Requirements

A. General

Refer to Section 700.02 for general material requirements, in addition to the following requirements.

B. Copper Pipe

Copper pipe shall be type K copper tubing in accordance with ASTM B698, Standard Classification for Seamless Copper and Copper Alloy Plumbing Pipe and Tube. The minimum diameter shall be three-fourth (¾) inch or shall match the existing pipe. Water main taps and transition fittings shall comply with the requirements of the Metropolitan Utilities District (MUD) rules and regulations.

705.03 Construction Requirements

A. General

Refer to Section 700.03 for general construction requirements, in addition to the following requirements.

A licensed plumber or workers under the direct supervision of a licensed plumber shall perform all work related to water service facilities. Comply with all applicable requirements of the City of Omaha Plumbing Code and Metropolitan Utilities District (MUD) Water Rules and Regulations regarding the installation, removal, and/or relocation of water service facilities. Obtain all necessary permits as required. Coordinate operations with utility companies to minimize interference with the removal, replacement, abandonment, and/or relocation of the underground and overhead utility operations. Maintain access to all fire hydrants at all times unless otherwise indicated in the Contract Documents. Do not store or stockpile materials within fifteen (15) feet of any fire hydrant.

Locate all utilities, sprinkler systems, or other underground services before commencing the work. The City is not responsible for any costs incurred due to damaged or destroyed utilities, sprinkler systems, or other underground services. All utilities shall remain in service unless otherwise indicated in the Contract Documents. Do not commence the work until making all necessary arrangements to protect all utilities. Notify the Engineer, the utility, and the property owner in the event of an interruption of water or utility services. Coordinate the repair operations to restore the service as soon as possible. Water service shall not be interrupted for more than twenty-four (24) hours.
B. Water Meters and Water Meter Manholes
Remove and/or relocate water meters and/or water meter manholes as indicated in the Contract Documents or as directed by the Engineer. Do not perform any work without notifying MUD. All work shall be performed in accordance with MUD rules and regulations.

Reconnect service lines using copper pipe to restore operation of the water meter. Remove and dispose of the existing water meter manhole after reconnecting the service lines.

C. Curb Stops and Curb Boxes
Existing curb stops shall remain in place unless otherwise indicated in the Contract Documents or as directed by the Engineer. Install new curb stops within the sidewalk or driveway, or a minimum of twelve (12) inches behind the proposed curb line. Curb stops shall be adjusted to final grade. Replace curb boxes as directed by the Engineer.

D. Service Pipe Replacement
Replace water service pipe at locations indicated in the Contract Documents or as directed by the Engineer using copper pipe in accordance with MUD rules and regulations. Replace all lead water service pipe, curb boxes, and curb stops from the corporation stop at the main to the existing curb stops or water meter manhole. Install a minimum three-fourth (¾) inch diameter copper pipe unless the existing diameter is greater than three-fourth (¾) inch, in which case match the larger diameter existing pipe.

E. Water Main Tap Construction
Water main taps shall be constructed at locations indicated in the Contract Documents and in accordance with the requirements of MUD rules and regulations.

F. Backfill
Backfill shall be in accordance with Section 700.03.

705.04 Acceptance
The Engineer shall observe the work to check for compliance with the Contract Documents, the City of Omaha Plumbing Code, and MUD rules and regulations. Backfill shall be constructed to the minimum compaction requirements identified in the Contract Documents. The Engineer shall verify the compaction of the backfill in accordance with the City of Omaha Materials and Testing Manual for Public Works Construction.

705.05 Measurement and Payment
The Engineer shall measure relocating water meters and water meter manholes for payment by each water meter and water meter manhole removed, relocated, and accepted.

The Engineer shall measure removing water meters and water meter manholes for payment by each water meter and water meter manhole removed, backfilled, and accepted.

The Engineer shall measure curb stops for payment by each curb stop supplied, installed, and accepted.

The Engineer shall measure curb boxes for payment by each curb box supplied, installed, and accepted.

The Engineer shall measure curb stops and curb boxes for payment by each curb stop and curb box supplied, installed, and accepted.
The Engineer shall measure copper pipe for payment by the linear feet of the size and method of installation of copper pipe supplied, installed, and accepted. The Engineer shall measure linear feet in the horizontal direction only.

The Engineer shall measure construction of water main taps for payment by the size of each water main tap supplied, constructed, and accepted.

Payment shall be made under the following unless otherwise indicated in the Contract Documents. The Contract Price shall be full compensation for excavation, trench protection, de-watering, removing existing water service facilities, backfilling, and pavement repair; for all testing and testing equipment; and for furnishing all labor, materials, equipment, tools, and all incidentals necessary to complete the work.

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relocate Water Meter and Water Meter Manhole</td>
<td>Each</td>
</tr>
<tr>
<td>Remove Water Meter and Water Meter Manhole</td>
<td>Each</td>
</tr>
<tr>
<td>Install Curb Stop</td>
<td>Each</td>
</tr>
<tr>
<td>Install Curb Box</td>
<td>Each</td>
</tr>
<tr>
<td>Install Curb Stop and Curb Box</td>
<td>Each</td>
</tr>
<tr>
<td>Install __” Copper Pipe – Open Cut</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Install __” Copper Pipe – Push</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Construct __” Water Main Tap</td>
<td>Each</td>
</tr>
</tbody>
</table>
Sewer Pipeline Inspection Using Closed-Circuit Television (CCTV)

706.01 General

A. Description

This work includes inspecting the interior of sewer pipeline systems using high quality video recording and data collection equipment to obtain pipeline information gathered for condition assessment and sewer acceptance. This work will generally apply to pipelines that have an inside diameter of eight (8) inches or greater.

B. Submittals

Refer to Section 700.01 B for submittal requirements.

706.02 Material Requirements

A. General

Refer to Section 700.02 for general material requirements.

706.03 Inspection Requirements

A. General

Refer to Section 700.03 for general construction requirements, in addition to the following requirements.

The Contractor shall provide the Engineer a minimum of twenty-four (24) hours notice before scheduling a video inspection or sewer cleaning operation. An independent sewer inspection service shall perform all video inspections. Do not commence the video inspection or sewer cleaning operation without the Engineer present.

Precautions shall also be taken to ensure that the cleaning operation and equipment will not cause any damage or flooding to public and/or private property being served by the sewer pipe being cleaned. All sludge, rocks, debris, etc. resulting from the pipe section being cleaned shall be removed from the immediate downstream manhole prior to inspection operations. Passing of debris from one pipe segment to the next is prohibited. The Contractor shall remove debris from the site and dispose of in accordance with Section 100. Storing of debris on site shall not be allowed.

B. Equipment

Accomplish video inspection using a closed-circuit television (CCTV) surveying system. The camera shall have built-in lights, three hundred sixty (360) degree pan, tilt, remote focus, and auto-iris functions. Lighting shall move with the camera head, be appropriate for the pipe diameter and material type, and provide sufficient illumination to clearly see along the pipe length. Granite XP™ software, a NASSCO PACP Certified software, shall be used to document all CCTV work unless otherwise indicated in the Contract Documents.

CCTV equipment shall include video cameras and wheeled or tracked transporters, video monitor, and all other necessary equipment required to perform the pipeline inspections as specified. The camera system shall provide a minimum three-hundred sixty (360) horizontal by two-hundred seventy (270) vertical degree rotation, operate under one-hundred (100) percent moisture conditions, and be able to zoom, pan, tilt, and focus when necessary. The camera height shall be adjustable to remain near the center of the pipe. Lighting intensity for the
camera shall be adjustable to provide adequate light for clear inspection and minimize glare on
the screen. The picture quality shall also be adjustable to provide a clear, in-focus picture.

Cameras used for all inspections shall record in color and shall provide an MPEG file at a
minimum of three-hundred fifty-two (352) by two-hundred forty (240) pixels resolution,
operate at a minimum of thirty (30) frames per second, and one-fourth (¼) MB per second data
recording rate. The Contractor shall have the ability to pause the digital recording any time
there is a delay or pause in the inspection and resume the digital video recording in the same
digital file. The Camera shall be able to take still images in JPEG format at a minimum of six-
hundred forty (640) by four-hundred eighty (480) pixels resolution.

The cable footage counter shall be calibrated and maintained in accordance with NASSCO
requirements.

Viewing software shall be provided to the Engineer and City at no additional cost.

C. Inspection

Thoroughly clean and remove all excess mortar, joint sealant, earth, and all other debris from
the pipe before inspection. Do not inspect the pipe during periods of water flowing through the
pipe unless otherwise directed by the Engineer.

1. Storm Sewer Inspection

All storm sewer pipes shall be inspected by either closed circuit television (CCTV) for pipe
less than seventy-two (72) inches in diameter or walking and observing for pipe seventy-
two (72) inches in diameter or greater. Do not perform inspections until all paving activities
are completed unless otherwise directed by the Engineer. Perform inspections after
construction of pavement, sidewalk, or other structures located above the pipe unless
otherwise directed by the Engineer. Any areas found defective shall be removed and
replaced in accordance with Section 702 at no additional cost to the City. Any defective
sewer line that is repaired shall be re-inspected. The cost of all re-inspection after the
correction of defects shall be at no additional cost to the City.

2. Sanitary Sewer Inspection

All sanitary sewer pipes eight (8) inches and larger shall be inspected by CCTV. Sanitary
sewer pipe inspection shall be performed a minimum of thirty (30) days after backfilling
operations are completed. Perform inspections before construction of pavement,
sidewalk, or other structures located above the pipe unless otherwise directed by the
Engineer. Any areas found defective shall be removed and replaced in accordance with
Section 703 at no additional cost to the City. Any defective sewer pipe that is repaired shall
be re-inspected. The cost of all re-inspection after the correction of defects shall be at no
additional cost to the City.

D. Report Information

The independent sewer inspection service shall furnish to the Engineer the following
information:

1. Written report.
2. Video(s) of the sewer inspection.
3. Photo(s) taken during the inspection of deficiencies.
4. Digital map(s) showing the pipelines and corresponding video inspections.
All information produced shall be submitted on a reusable external hard drive or USB compatible flash drive labeled with the following information:

1. Project name.
2. City project number.
3. Name of independent sewer inspection service.
4. Date(s) of inspection work.

The written report shall contain the location and position of all connections, a written summary of the apparent condition and alignment of the sewer, and indexed pictures of all misalignments, cracks, offset joints, faulty gaskets, obstructions, breaks, exposed filler material, and water infiltration points. The reports, produced by Granite XPTM software, shall be: TV Inspection with Pipe-Run Graph; Observation Report with Still Images; PACP Sewer Report.

The video shall provide viewing of the starting access point by facing the pipe segment to be televised and gradually panning the camera up and around the entire structure. Pan, tilt, and zoom shall be used to locate all connecting pipes in the structure. The beginning point of the inspection shall be the center of the structure. The camera footage counter shall provide accurate length measurements from centerline of the beginning structure to centerline of ending structure. If a reverse set-up was required, provide the reason the CCTV was not completed in the direction of flow and any other significant remarks or observations.

The naming of CCTV video files shall include the upstream manhole ID, downstream manhole ID, and date of inspection. The video shall display data fields from the inspection report at the start of the video for a minimum of ten (10) seconds. Unless otherwise stated in the Contract Documents or directed by the Engineer in writing, the required data fields include the following:

1. Date and time.
2. Camera operator’s name and PACP certificate number.
3. Project name.
4. City project number.
5. Location.
6. Upstream manhole ID.
7. Downstream manhole ID.
8. Pipe run ID.
10. Pipe material and pipe diameter.
12. Additional information and/or comments.

The digital map shall be labeled to show the pipelines inspected corresponding to the video(s) and report(s), the manhole ID’s, pipe run ID’s, and show the project name and City project number. The map can be an annotated vicinity map from the Contract Documents.
706.04 Acceptance

The Engineer shall observe the work to check for compliance with the Contract Documents. The Engineer may conduct independent quality assurance and quality control reviews.

A. Inspection Report

The independent sewer inspection service shall submit the inspection results to both the Engineer and the Contractor for review. The Engineer shall review all information submitted in the report. Video recorded with inadequate lighting and/or poor image quality or otherwise not conforming to this specification shall be unacceptable and may require re-inspection of the pipe(s) at no additional cost to the City. Any replacement or repair work resulting from any identified defects shall be inspected again at no additional cost to the City.

B. Repair of Defects

The Contractor shall be responsible for reviewing the report(s) and video(s) to resolve any inconsistent and conflicting data. The Contractor shall repair all identified defects in the sewer systems in accordance with Sections 702 and/or 703, and at no additional cost to the City. An independent sewer inspection service shall re-inspect any repair work resulting from any identified defects at no additional cost to the City.

706.05 Measurement and Payment

Unless otherwise indicated in the Contract Documents, CCTV inspection of all sewer pipes shall be subsidiary to items for which the contract provides direct payment. The Engineer shall measure CCTV inspections for payment by the linear feet of sewer pipe inspected, reported, and accepted. The Engineer shall conduct measurements along the horizontal surveyed centerline(s) of all sewer pipes from center to center of all manholes.

Unless otherwise indicated in the Contract Documents, sanitary sewer cleaning of all sewer pipes shall be subsidiary to items for which the contract provides direct payment. The Engineer shall measure cleaning sanitary sewer pipes for payment by the linear feet of sanitary sewer pipe cleaned and accepted. The Engineer shall conduct measurements along the horizontal surveyed centerline(s) of all sanitary sewer pipes from center to center of all manholes.

Payment will be made under the following unless otherwise indicated in the Contract Documents. The Contract Price shall be full compensation for cleaning of pipes, removal of accumulated debris, preparing and supplying the reports and videos, and for all labor, equipment, tools and incidentals necessary to complete the work.

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perform CCTV Pipeline Inspection</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Clean Sanitary Sewer Pipe</td>
<td>Linear Foot</td>
</tr>
</tbody>
</table>
707 Sanitary Sewer Force Main Construction

707.01 General
   A. Description
      This work includes furnishing and construction of sanitary sewer force mains and appurtenances
      along the lines and grades indicated in the Contract Documents or as directed by the Engineer.
      Unless otherwise indicated in the Contract Documents, install Ductile Iron Pipe (DIP), Polyvinyl
      Chloride (PVC) pipe, and polyethylene (PE) pipe using open-cut excavation in accordance with
      the following requirements.

   B. Submittal Requirements
      Refer to Section 700.01 B for submittal requirements.

707.02 Material Requirements
   A. General
      Refer to Section 700.02 for general material requirements, in addition to the following
      requirements.

   B. Sanitary Sewer Force Main Pipe Materials
      Sanitary sewer force main pipe materials include DIP, PVC pipe, and PE pipe. The Engineer shall
      coordinate with the City for any alternate pipe material.

      1. Ductile Iron Pipe (DIP) and Fittings
         a. General
            DIP and fittings shall be in accordance with ANSI/AWWA C110/A21.10, Standard for
            Ductile-Iron and Gray-Iron Fittings; ANSI/AWWA C150/A21.50, Standard for
            Thickness Design of Ductile Iron Pipe; and ANSI/AWWA C151/A21.51, Ductile-Iron
            Pipe, Centrifugally Cast.

            Buried DIP and fittings shall be wrapped in polyethylene encasement in accordance
            with ANSI/AWWA C105/A21.5, Polyethylene Encasement for Ductile-Iron Pipe
            Systems.

            Pressure class of pipe shall be as indicated in the Contract Documents.

         b. Interior Lining and Exterior Coating
            DIP shall have an interior bitumastic liner or sulfuric acid resistant cement grout liner
            in accordance with ANSI/AWWA C104/A21.4, Cement-Mortar Lining for Ductile Iron
            Pipe and Fittings; or a two-coat ceramic epoxy liner in accordance with ANSI/AWWA
            C116/A21.16, Protective Fusion-Bonded Coatings for the Interior and Exterior
            Surfaces of Ductile-Iron and Gray-Iron Fittings.

            DIP shall have an exterior coating in accordance with ANSI/AWWA C151/A21.51,
            Ductile-Iron Pipe, Centrifugally Cast.

         c. Joints and Accessories
            Joints and accessories shall be mechanical in accordance with ANSI/AWWA
            C111/A21.11, Standard for Rubber-Gasket Joints for Ductile-Iron and Gray-Iron
            Pressure Pipe and Fittings.
2. Polyvinyl Chloride (PVC) Pipe and Fittings
   a. General
      PVC pipe and fittings shall be in accordance with AWWA C900, Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 60 In.; and ASTM D1784, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
      Pressure class of pipe shall be as indicated in the Contract Documents.
   b. Joints and Gaskets

3. Polyethylene (PE) Pipe and Fittings
   a. General
      PE pipe and fittings shall be in accordance with AWWA C906, Standard for Polyethylene (PE) Pressure Pipe and Fittings, 4 In. through 63 In., for Water Distribution; and ASTM F714, Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter.
      Pressure class of pipe shall be as indicated in the Contract Documents.
   b. Joints and Gaskets

C. Underground Warning Tape
   Warning tape shall be six (6) inches wide and three and one-half (3.5) millimeters thick polyethylene warning tape with minimum of one-thousand seven-hundred fifty (1,750) pounds per square inch tensile strength. Warning tape shall be preprinted with a continuous message and a permanently imbedded legend.

D. Tracer Wire and Accessories
   Tracer wire shall be solid single copper conductor, #12 American Wire Gage (AWG) high strength copper clad steel conductor (HS-CCS). Wire insulation shall be thirty (30) millimeter high molecular weight – high density polyethylene (HMW-HDPE) insulation and rated for direct burial use at thirty (30) volts. Wire nuts and brass split bolts shall be waterproof.

707.03 Construction Requirements
A. General
   Refer to Section 700.03 for general construction requirements, in addition to the following requirements. All sanitary sewer force main pipe crossings of water mains shall be in accordance with the Recommended Standards for Wastewater Facilities (Ten State Standards).
   The Contractor shall install a watertight plug to prevent foreign matter from entering the pipe during periods of inactivity.
B. Additional Requirements

1. DIP Installation
   Install DIP and fittings in accordance with ANSI/AWWA C600, Standard for Installation of Ductile-Iron Water Mains and Their Appurtenances. The Contractor shall protect the interior lining per the manufacturer’s recommendations. Clean joints prior to gasket installation. Install DIP with loose polyethylene encasement. Replace polyethylene encasement that is torn or damaged at no additional cost to the City.

   Provide restrained joint pipe as indicated on the Contract Documents, or as directed by the Engineer.

2. PVC Installation
   Install PVC pipe and fittings in accordance with ANSI/AWWA C605, Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings.

   Provide restrained joint pipe as indicated on the Contract Documents, or as directed by the Engineer.

   Install mechanical restraints for PVC pipe connecting to ductile iron fittings in accordance with the manufacturer’s recommendations.

3. PE Pipe Installation
   Install PE pipe and fittings in accordance with ASTM D2774, Standard Practice for Underground Installation of Thermoplastic Pressure Piping.

   Provide restrained joint pipe as indicated on the Contract Documents, or as directed by the Engineer.

   Install PE transition adapters for PE pipe connecting to ductile iron fittings in accordance with the manufacturer’s recommendations.

4. Tracer Wire and Underground Warning Tape Installation
   For PVC and PE pipe installations, install tracer wire flat and securely affixed to the pipe at maximum ten (10) foot intervals with tape or tie wraps. Install wire with some slack. If split bolts are used for splicing, wrap with electrical tape. If wire nuts are used for splicing, knot wire at each splice point leaving six (6) inches of wire for splicing.

   Install warning tape twenty-four (24) inches below grade above the top centerline of the pipe.

C. Connections to Existing Pipelines and Structures
   Connect the pipe to existing structures or pipelines at the locations indicated in the Contract Documents or as directed by the Engineer. Prepare existing structures by cutting or otherwise constructing an opening with a minimum clearance of two (2) inches on all sides. Position the force main pipe and fill the opening between pipe and structure using an expansive grout, rubber gasket, or other material to provide a watertight seal.

707.04 Acceptance
   Before installing pipe, inspect the pipe for cracks or other damage. Damaged pipe sections include any pipe section with a defect that materially affects the pipe’s ability to function as
intended. Damaged pipe sections shall not be installed and shall be removed from the site and replaced at the Contractor’s expense.

The Engineer shall observe the work to check for compliance with the Contract Documents. Remove any soil, debris, or other unwanted material from the sanitary sewer force main upon completion of installation and prior to any acceptance testing.

Acceptance testing for sanitary sewer force main piping shall consist of hydrostatic pressure testing in accordance with ASTM E1003, Standard Practice for Hydrostatic Leak Testing. Do not permit live wastewater flow in the sanitary sewer force main until all testing is completed and found acceptable, unless otherwise indicated in the Contract Documents. Perform pipe testing prior to completing backfill construction. All joints, including welds, are to be left exposed for examination during the test. The Contractor shall notify the Engineer a minimum of twenty-four (24) hours before scheduling testing. The Contractor shall not perform any acceptance testing without the Engineer present. All pipe installation(s) with failing tests shall be located, corrected, and retested at no additional cost to the City. The Contractor shall be responsible for any damages to public or private property caused by failure of pipe plugs.

All sanitary sewer force main pipe shall be hydrostatically tested with water in accordance with ASTM E1003, Standard Practice for Hydrostatic Leak Testing. The minimum test pressure is one and one-quarter (1.25) more than the shutoff head pressure of the pump. The test duration shall be a minimum of six (6) hours. Perform pressure tests using calibrated pressure gauges and calibrated volumetric measuring equipment to determine leakage rates. An independent calibration agency shall calibrate gauges at a maximum interval of one time every twelve (12) months. Provide the certification of calibration for all gauges to be used to the Engineer before commencing hydrostatic testing. Re-calibrate suspect gauges as required by the Engineer.

707.05 Measurement and Payment

The Engineer shall measure sanitary sewer force main pipe for payment by the linear feet of the size and type of sanitary sewer force main pipe supplied, constructed, bedded, backfilled, and accepted. The Engineer shall conduct measurements along the horizontal surveyed centerline of all sanitary sewer force main pipe from the inside faces of structures. Construction of couplers, bends, fittings, and accessories shall be considered incidental to construction of the sanitary sewer force main pipe.

The Engineer shall measure DIP encasements for payment by the linear feet of DIP encasement constructed and accepted.

The Engineer shall measure connections to existing structures for payment by each connection constructed and accepted.

Payment shall be made under the following unless otherwise indicated in the Contract Documents. The Contract Price shall be full compensation for excavation, trench protection, de-watering, pipe installation, pipe fittings, gaskets, pipe and joint mortar, warning tape, tracer wire, bedding, backfilling, compaction, exposing locations for testing, and cleanup and disposal of excess material; for all acceptance testing and all testing equipment, water, anchors, and braces; and for furnishing all labor, materials, equipment, tools, and incidentals necessary to complete the work.
<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construct ___” DIP Sanitary Sewer Force Main, Class ___</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Construct ___” DIP Encasement</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Construct ___” PVC Sanitary Sewer Force Main, SDR ___</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Construct ___” PE Sanitary Sewer Force Main, SDR ___</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Construct Connection to Existing Structure</td>
<td>Each</td>
</tr>
</tbody>
</table>
SECTION 800 – ROADSIDE IMPROVEMENT AND EROSION CONTROL

800 Roadside Improvement and Erosion Control

800.01 General

A. Description

The information, submittal requirements, material requirements, and construction requirements shall apply to all subsections within Section 800 unless otherwise specified. This section includes topsoil, seeding, sodding, hydro seeding, rolled erosion control, plant materials, rock rip rap, gabion baskets and revet mattresses, and fences.

It is the Contractor’s responsibility to be knowledgeable of and meet the requirements of all applicable permits, including but not limited to the National Pollutant Discharge Elimination Systems (NPDES), Storm Water Pollution Prevention Plan (SWPPP), Dewatering, Grading, Post Construction Storm Water Management Plan (PCSMP), and other applicable permits and/or requirements.

B. Submittal Requirements

The Contractor shall submit, in accordance with the General Conditions, the following submittals:

1. Organic soil additive certification letter from supplier indicating material source and statement that material meets the required criteria.
2. Copy of any written agreements with private landowners for temporary use of land.
3. Seed tag with the variety, origin, and analysis of the seed for each seed bag.
5. Certificate for mulch for seeding stating “Noxious Weed Free” by the “County Weed Control Authority” or other authorized agents.
6. Certified weight scale ticket for each load of mulch for seeding delivered to the project.
7. Supplier source certification for sod material.
8. Hydro seed certification letter from supplier indicating material composition of mixture and installation recommendations.
9. If the Contract Documents do not contain details or plant material requirements, the Contractor shall submit a plan, material information, and installation details signed by a Landscape Architect licensed in the State of Nebraska.
10. Supplier source certification for nurseries providing plant materials, including the number of plants from each nursery and the type of plant species and/or varieties supplied.
11. Affidavit from nursery stating project number, date, and place of wilt-proofing (for coniferous materials); and the number and type of materials covered by the affidavit.
12. Material delivery tickets identifying the species, varieties, boxes, bundles, bales, or other containers for all plant materials. Tickets shall identify the botanical genus, species, common name, and size or age of each species or variety of plant.
13. Compost material certifications.
14. Rolled erosion control or turf reinforcement material certifications and manufacturer’s installation recommendations.
15. Rock certifications for rip rap, gabion basket, and revet mattress fill material.
16. Gabion or wire mesh basket material certifications and manufacturer’s installation recommendations.
17. Fence material and components certifications and manufacturer’s installation recommendations.
18. Soil Test analysis reports for each sample of topsoil from an approved independent soil-testing laboratory.

800.02 Material Requirements
   A. General
      Refer to specific sections within Section 800 for material requirements.

800.03 Construction Requirements
   A. General
      Refer to specific sections within Section 800 for construction requirements.
801 Topsoil

801.01 General

A. Description
This work includes the removal of topsoil from cut or fill areas in such quantity as required to cover the slopes, ditches, and shoulders in accordance with the Contract Documents; loading, hauling, stockpiling if necessary; and the subsequent placing, spreading and finishing of the topsoil material in accordance with the Contract Documents or as directed by the Engineer.

B. Submittal Requirements
Refer to Section 800.01 B for submittal requirements.

801.02 Material Requirements

A. General
Material requirements shall be in accordance with the Contract Documents, in addition to the following requirements.

B. Topsoil
Topsoil material shall be loam, sandy loam, silty clay loam, or clay loam humus-bearing soils. Imported topsoil shall be in accordance with ASTM D5268, Standard Specification for Topsoil Used for Landscaping Purposes. The Contractor shall reuse topsoil removed and stockpiled on the project unless otherwise indicated in the Contract Documents or authorized by the Engineer.

C. Topsoil Test
When a topsoil test is indicated in the Contract Documents, soil amendments are to be constructed per the recommendations of an AASHTO Materials Reference Laboratory-certified (AMRL) topsoil testing laboratory. The following testing requirements and protocols shall be followed for onsite and offsite topsoil products:

1. ASTM D3665, Standard Practice for Random Sampling of Construction Materials;
2. ASTM D5268, Standard Specification for Topsoil Used for Landscaping Purposes;
3. ASTM D422, Standard Test Method for Particle-Size Analysis;
4. Soil Classifications shall be defined by the USDA NRCS Urban Soil Primer, 2005;
5. Chemical analysis, performed in accordance with current Association of Official Analytical Chemists (AOAC) Standards will include the following:
   a. pH and Buffer pH;
   b. Percent organic matter as determined by the loss of ignition of oven dried samples. Test samples shall be oven dried to a constant weight at a temperature of two-hundred thirty (230) degrees Fahrenheit, plus or minus nine (9) degrees;
   c. Analysis for nutrient levels by parts per million including calcium, magnesium and micronutrient levels. Nutrients test shall include the testing laboratory recommendations for supplemental additions to the soil as calculated by the amount of material to be added per volume of soil for the type of plants to be grown in the soil;
d. Soluble salt by electrical conductivity of a soil to water ratio of one to two (1:2) soil/water sample measured in millimho per cm;

e. Cation Exchange Capacity (CEC) shall be greater than ten (10).

D. Amended Topsoil

When indicated in the Contract Documents, and when a topsoil test is not performed, amended topsoil shall be existing topsoil that is mixed with an organic soil additive. Organic soil additive shall be in accordance with Table 801.01. The amended topsoil shall contain between five (5) percent to ten (10) percent organic matter.

<table>
<thead>
<tr>
<th>Description</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passing ⅜” Sieve</td>
<td>100%</td>
</tr>
<tr>
<td>pH</td>
<td>Between 6 and 8</td>
</tr>
<tr>
<td>Manufactured Inert Material Content (Plastic,</td>
<td>Less than 1.0% by Weight</td>
</tr>
<tr>
<td>Concrete, Ceramics, Metal, etc.)</td>
<td></td>
</tr>
<tr>
<td>Organic Matter</td>
<td>Between 35% and 65%</td>
</tr>
<tr>
<td>Soluble Salt Content</td>
<td>Less than 6.0 mmhos/cm</td>
</tr>
<tr>
<td>Maturity</td>
<td>Greater than 80%</td>
</tr>
<tr>
<td>Stability</td>
<td>Less than or equal to 7</td>
</tr>
<tr>
<td>Carbon/Nitrogen Ratio</td>
<td>Less than 25:1</td>
</tr>
<tr>
<td>Trace Metal Test Result</td>
<td>“Pass”</td>
</tr>
<tr>
<td>Dry Bulk Density</td>
<td>Between 40 and 50 lbs/ft³</td>
</tr>
</tbody>
</table>

801.03 Construction Requirements

A. General

Complete clearing and grubbing operations in accordance with Section 100 before removing the topsoil. Install all appropriate erosion and sediment controls in accordance with the Contract Documents and Section 100 before removing topsoil. Remove topsoil in a manner that avoids incorporating subsoil or other foreign materials with the topsoil. Remove topsoil to a minimum depth of six (6) inches unless otherwise indicated in the Contract Documents or as directed by the Engineer.

Stockpile topsoil before beginning earthwork operations. Stockpiles shall not interfere with natural drainage or cause off-site sediment damage. The Contractor shall limit stockpile side slopes to a ratio of 1V:3H. Immediately upon completion of daily stockpiling activities, the Contractor shall surround all stockpiles with erosion and sediment controls. The Contractor may enter agreements with adjacent landowners, or other persons for areas to stockpile the topsoil material. Such agreements shall remain separate from the Contract.

Place topsoil during conditions favorable for grading, sodding, and seeding. Before placing topsoil, scarify areas receiving topsoil to a minimum depth of two (2) inches. Place topsoil evenly to a lightly compacted depth of at least four (4) inches. Remove clods, rocks, twigs, and other foreign material greater than one (1) inch diameter. Dress the entire surface to present a uniform appearance. Add water as necessary to facilitate shaping. The finished work shall conform to the lines, grades, slopes, and typical cross sections indicated in the Contract.
Documents. Correct surface irregularities to prevent the formation of depressions or water pockets.

Dispose of any excess topsoil to be removed from the project. Such removal and disposal is subsidiary to items for which the Contract provides direct payment.

B. Topsoil Test

At least thirty (30) days prior to starting topsoil work, the Contractor shall submit to the Engineer the test results for topsoil from an independent AASHTO Materials Reference Laboratory-certified (AMRL) soil-testing laboratory. If it is identified that topsoil is to be amended as part of the test results, no materials shall be ordered until the required samples, certifications, supplier’s literature and test results have been reviewed by the Engineer.

C. Amended Topsoil

The Contractor shall notify the Engineer five (5) days prior to the start of amended topsoil activities. Construct amended topsoil at locations shown and in accordance with the Contract Documents and the Omaha Regional Stormwater Design Manual.

In previously disturbed areas where topsoil has been removed and stockpiled, the Contractor shall place the amended topsoil in accordance with the Contract Documents or Section 801.03.A. Amending topsoil may be accomplished by mixing the organic soil additive with a stockpile of topsoil material then placing, or by spreading the organic soil additive over replaced topsoil and mixing together in place.

In previously undisturbed areas, organic soil additive may be spread over undisturbed native soil to a depth of three (3) inches and incorporated into the native soil to a total depth of six (6) inches.

801.04 Acceptance

The Engineer shall observe the work to check for compliance with the Contract Documents.

801.05 Measurement and Payment

The Engineer shall measure topsoil removals for payment by the square yards of topsoil removed, stockpiled, and accepted.

The Engineer shall measure topsoil placement for payment by the square yards of topsoil placed and accepted.

The Engineer shall measure topsoil tests for payment by each test taken in the field, analyzed, and submitted for review to the Engineer.

The Engineer shall measure amended topsoils for payment by the square yards of topsoil delivered and placed, organic soil additive delivered and placed and fully incorporated into topsoil, and accepted.

Payment shall be made under the following unless otherwise indicated in the Contract Documents. The Contract Price shall be full compensation for all excavating, loading, hauling, stockpiling, furnishing, placing, incorporating, shaping, grading, and applying water; for disposing of excess material; and for furnishing all labor, materials, equipment, tools, and all incidentals necessary to complete the work.
<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remove Topsoil</td>
<td>Square Yard</td>
</tr>
<tr>
<td>Place Topsoil</td>
<td>Square Yard</td>
</tr>
<tr>
<td>Topsoil Test</td>
<td>Each</td>
</tr>
<tr>
<td>Amend Topsoil</td>
<td>Square Yard</td>
</tr>
</tbody>
</table>
802 Revegetation

802.01 General

A. Description

This work includes furnishing and placing seed, fertilizer, and mulch; furnishing, cutting, and placing sod; and furnishing and placing hydro seed in accordance with and at the locations indicated in the Contract Documents or as directed by the Engineer. Perform Irrigated Lawn and Turf seeding in yards, golf courses, or other similar irrigated areas. Perform Type A seeding in well-maintained areas such as parks, subdivisions, or other similar areas without irrigation. Perform Type B seeding in median areas and areas twelve (12) feet or wider and adjacent to pavement, surfaced shoulders, or curb.

B. Submittal Requirements

Refer to Section 800.01 B for submittal requirements.

802.02 Material Requirements

A. General

Material requirements shall be in accordance with the Contract Documents, in addition to the following requirements.

B. Seed

All seed origins shall be State of Nebraska or adjoining states. Submit a seed tag to the Engineer that describes the variety, origin, and analysis of the seed. All seed must comply with applicable local, state, and federal seed laws.

C. Irrigated Lawn and Turf Seed

Irrigated lawn and turf seed shall be Interagency Bluetag Certified and shall have a minimum germination of ninety (90) percent and a purity of ninety-eight (98) percent. Proportion the seed in accordance with Table 802.01. The recommended use for this type of seed is for areas with irrigation or areas mowed at short height.

<table>
<thead>
<tr>
<th>Seed Type</th>
<th>Blend Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kentucky Blue Grass</td>
<td>7 +/- 1</td>
</tr>
<tr>
<td>Tall Fescue</td>
<td>93 +1/-6</td>
</tr>
<tr>
<td>Perennial Rye Grass</td>
<td>0 +5</td>
</tr>
</tbody>
</table>

D. Type A Seed

Type A seed shall be tall fescue. The recommended use for this type of seed is for parks, subdivision lots, or other areas without irrigation where finish mowing techniques are applied.

E. Type B Seed

Type B seed shall be a blend of K-31 or Fawn fescue, perennial rye grass, and smooth brome grass having a minimum purity of ninety (90) percent. Proportion the seed in accordance with Table 802.02. The recommended use for this type of seed is for low maintenance areas mowed several times a year, or other areas without irrigation.
Table 802.02
Type B Seed Blend

<table>
<thead>
<tr>
<th>Seed Type</th>
<th>Blend Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>K-31 or Fawn Fescue</td>
<td>30 +5/-0</td>
</tr>
<tr>
<td>Perennial Rye Grass</td>
<td>20 +0/-5</td>
</tr>
<tr>
<td>Smooth Brome Grass</td>
<td>30 ± 5</td>
</tr>
<tr>
<td>Cover Crop</td>
<td>20 +5/-0</td>
</tr>
</tbody>
</table>

F. Fertilizer

Fertilizer shall be an inorganic product containing sixteen (16) to eighteen (18) percent nitrogen and forty-six (46) to forty-eight (48) percent phosphoric acid in a recognized plant nutrient form. Fertilizer shall be in accordance with the current provisions of the Nebraska Fertilizer Act of 1955. Furnish and deliver fertilizer in standard weight bags or bulk. Provide a fertilizer certification form to the Engineer for every load of bulk fertilizer delivered to the project.

G. Hay or Straw Mulch

Hay or straw mulch shall be either dry cured native prairie hay, native grass hay from seed growing operations, native grass hay from planted warm season grass stands, or threshed grain straw. Straw shall be from threshed oats, wheat, or rye. Brome hay is not allowed.

Hay or straw mulch shall be certified as “Noxious Weed Free” by the “County Weed Control Authority” or other authorized agents. The certification or a copy shall accompany each load of mulch. The certification shall be placed in a weather-proof container and attached to the stack of mulch it represents. Hay or straw mulch in a stage of decomposition so advanced as to disintegrate or powder in the mulch blower shall be rejected.

The Contractor shall notify the Engineer of the hay or straw source before delivering such material to the project. The Engineer reserves the right to reject the hay or straw source for any reason. Do not deliver hay or straw to the project until the Engineer has approved the source.

All mulch deliveries shall have tickets from a State certified scale before the mulch is unloaded for use on the project. The scale ticket shall indicate the weight and be dated and signed by the scale operator. The scale ticket shall be given to the Engineer or left in a weather-proof container and attached to the stack of mulch it represents. The Engineer may, at any time, order the Contractor to reweigh the mulch as a check of the scale ticket.

H. Cover Crop or Temporary Seed

Cover crop or temporary seed shall be alfalfa and oats prior to August 15th, and alfalfa and winter wheat from August 16th through November 15th. The recommended use for this type of seed is to establish a temporary growth of site stabilizing vegetation outside of the permanent seeding periods due to phasing of the work or other similar time constraints.

I. Channel Seed

Channel seed shall be tall fescue mixed with brome and switch grass, each having a minimum purity of ninety (90) percent. Proportion the seed in accordance with Table 802.03. The recommended use for this type of seed is for channels or drainage ditches.
Table 802.03
Channel Seed Blend

<table>
<thead>
<tr>
<th>Seed Type</th>
<th>Blend Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smooth Brome</td>
<td>40 +/-5</td>
</tr>
<tr>
<td>Tall Fescue</td>
<td>40 +/-5</td>
</tr>
<tr>
<td>Switch Grass</td>
<td>5 +/-2</td>
</tr>
<tr>
<td>Cover Crop</td>
<td>15 +5/-0</td>
</tr>
</tbody>
</table>

J. Native Seed

Native seed shall be a blend of fescue seeds mixed with bluestem and gramas, each having a minimum purity of ninety (90) percent. Proportion the seed in accordance with Table 802.04. The recommended use for this type of seed is for low maintenance areas. Cover crop shall be blended into the native seed mix in accordance with the manufacturer’s recommendations.

Table 802.04
Native Seed Blend

<table>
<thead>
<tr>
<th>Seed Type</th>
<th>Blend Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue Fine Fescue</td>
<td>20 +/-5</td>
</tr>
<tr>
<td>Hard Fine Fescue</td>
<td>20 +/-5</td>
</tr>
<tr>
<td>Sheep Fine Fescue</td>
<td>20 +/-5</td>
</tr>
<tr>
<td>Sideoats Grama</td>
<td>15 +/-5</td>
</tr>
<tr>
<td>Little Bluestem</td>
<td>15 +/-5</td>
</tr>
<tr>
<td>Blue Grama</td>
<td>10 +/- 5</td>
</tr>
</tbody>
</table>

K. Sod

Submit the proposed source of sod. The sod shall be a first-class representation of normal species and varieties of bluegrass or turf-type tall fescue. Sod shall be free of noxious weeds and relatively free of all other weeds.

Mow and rake the sod to remove stems, sticks, and grass clippings before cutting. Sod shall not be cut more than forty-eight (48) hours before placement. When stripping, cut the sod one (1) to two (2) inches below the base of the grass stem. Sod shall be moist before cutting and shall be kept moist until placed. Handle and transport the sod to avoid unnecessary damage to and loss of earth from the roots of the sod.

L. Sod Fertilizer

Sod fertilizer shall an inorganic product containing ten (10) to twelve (12) percent each of nitrogen, phosphorus, and potassium in a recognized plant nutrient form. Sod fertilizer shall be in accordance with the current provisions of the Nebraska Fertilizer Act of 1955. Furnish and deliver sod fertilizer in standard weight bags or bulk. Provide a sod fertilizer certification form for every load of bulk fertilizer delivered to the project. Sod fertilizer with pre-emergent shall be applied before August 15th.

M. Sod Stakes

Sod stakes shall be wood lathe and have a minimum length of eight (8) inches. Do not use other types of stakes or materials without written approval from the Engineer.
N. Hydro Seed

Hydro seed shall consist of a mixture of soil stabilizing compound material, wood fiber mulch, compost and/or fertilizer, and grass seed as indicated in the Contract Documents. The material requirements of each component of the mixture shall be per the recommendations of the manufacturer or as directed by the Engineer.

802.03 Construction Requirements

A. General

Notify the Engineer a minimum of forty-eight (48) hours before commencing the work. Perform permanent seeding operations from March 15th to May 31st, or from August 15th to September 30th. The Contractor may request alternate permanent seeding dates, but such requests do not alter any warranty or establishment condition requirements.

Perform cover crop or temporary seeding operations outside the permanent seeding periods or when directed by the Engineer, and in accordance with the Contract Documents. The Contractor may request to perform dormant seeding when ground temperatures are cold enough to restrict seed germination. If approved, perform dormant seeding after November 15th, but such requests do not alter any warranty or establishment conditions requirements.

Do not perform seeding or fertilizing operations if the ground is wet, frozen, or otherwise untillable. Do not perform seeding or fertilizing operations when conditions do not allow for a uniform distribution of materials.

Perform sodding operations from March 15th to June 1st, or September 1st to December 1st. The Contractor may request alternative dates, but such requests do not alter any warranty or establishment condition requirements. Do not perform sodding operations if the ground is frozen, or during weather conditions unfavorable for growth. Perform sodding operations as soon as possible after completing the finish grading on a section of the project.

B. Seed Bed Preparation

Prepare the seedbed by scarifying the upper two (2) inches of the soil a maximum of three (3) days before the sowing of seed. Perform diskimg, harrowing, and raking in the longitudinal direction on all slopes steeper than 1V:4H. When indicated in the Contract Documents, topsoil shall be in accordance with Section 801.

C. Seed Application

Apply seed using a mechanical power-drawn drill equipped with press wheels or drag chains. Do not use hydraulic seeders or broadcast-type seeders without written authorization from the Engineer. Apply seed in accordance with Table 802.05. Maintain a planting depth of one-half (½) to three-fourth (¾) inches when using a mechanical power-drawn drill.
Table 802.05
Seed Application Rates

<table>
<thead>
<tr>
<th>Seed Type</th>
<th>Application Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Irrigated Lawn and Turf</td>
<td>435 Pounds</td>
</tr>
<tr>
<td>Type A</td>
<td>435 Pounds</td>
</tr>
<tr>
<td>Type B</td>
<td>125 Pounds</td>
</tr>
<tr>
<td>Channel Seed</td>
<td>100 Pounds</td>
</tr>
<tr>
<td>Native Seed</td>
<td>32 Pounds</td>
</tr>
<tr>
<td>Cover Crop or Temporary</td>
<td>80 Pounds</td>
</tr>
</tbody>
</table>

D. Fertilizing

Apply fertilizer using a mechanical spreader to uniformly place fertilizer over all areas receiving permanent seed. Apply fertilizer at a rate of one-hundred sixty (160) pounds per acre. Do not blend any fertilizer without the Engineer’s approval.

E. Mulch

Apply mulch within twenty-four (24) hours after seeding. Furnish the equipment and labor necessary for accurate placement of the specified quantities. Do not place mulch if the wind velocity is too great to allow uniform distribution of the mulch materials.

Loosely place the mulch to allow sunlight to penetrate and air to slowly circulate. Place the mulch at a thickness that shades the ground, reduces the rate of evaporation, and prevents or reduces erosion due to water or wind.

Apply mulch using a mulch-blowing machine at a rate of two (2) tons per acre. Anchor the mulch using a mulch crimper or similar equipment with straight disc blades without camber immediately after spreading. Use a mulch crimper equipped with a ballast compartment that allows an increase or decrease in the weight. Crimp mulch the same day that it is applied.

F. Sod Bed Preparation

Clear all areas receiving sod of debris and dead vegetation before preparing the sod bed. Place topsoil in accordance with Section 801 when required by the Contract Documents or directed by the Engineer. Compact any loose soils lightly to create a uniform sod bed. The sod bed shall not have a crusted appearance. Apply fertilizer on top of the prepared sod bed at the sod supplier’s recommended rate. Treat the sod bed using a siduron pre-emergent grass herbicide when installing sod before August 15th. Apply the pre-emergent grass herbicide at the manufacturer’s recommended rate.

G. Sod Placement

Do not lay sod that has dry or dead edges. Lay the sod over the sod bed with strips edge to edge leaving no discernable void spaces between the strips or surrounding improvements. Lay the sod approximately one (1) inch below adjoining paved or seeded surfaces and flush with adjoining sod. Stake any sod placed on slopes steeper than 1V:3H or in ditch bottoms to prevent movement. Drive stakes flush with the sod line and with the broad face of the stake facing the slope. Roll all sod not staked one (1) time using a sod roller. Thoroughly water all sod immediately after placing.
H. Hydro Seed Application

Hydro seed shall be blended and applied in accordance with the manufacturer’s recommendations. Application rates shall be as recommended by the manufacturer for the type of soil and slope of the area to which hydro seed is applied. Damaged areas shall be repaired using the same blend and application procedure as originally applied.

I. Seed Establishment Period

The Contractor shall request the commencement of the establishment period. The establishment period will not begin until completion of all seeding as indicated in the Contract Documents. After the seed mixture has germinated, reseed all areas which have failed to show a uniform stand of germinated seed. Maintain all seeded areas for a minimum of sixty (60) days, or until final acceptance of the seeded areas, whichever is longer. Suggested maintenance items shall include, but not be limited to, any or all of the following, whichever are necessary: re-grading, re-fertilizing, reseeding, re-mulching, watering, weeding, rolling, or filling in eroded areas. The cost to maintain is subsidiary to items for which the Contract provides direct payment.

J. Sod Establishment Period

The Contractor shall request the commencement of the establishment period. The establishment period will not begin until completion of all sodding as indicated in the Contract Documents. The Contractor shall thoroughly water all sodded areas to maintain consistent soil moisture and establish uniform root growth for a minimum of thirty (30) days after placement of the sod materials. After thirty (30) days re-sod and maintain any areas that do not have an established root growth. All sod must be moist and growing at the time of acceptance. The cost to maintain, and re-sod, if necessary, is subsidiary to items for which the Contract provides direct payment.

802.04 Acceptance

The Engineer shall observe the work to check for compliance with the Contract Documents.

No seeded areas shall be inspected for acceptance prior to sixty (60) days from date of seeding. The Contractor shall submit a written notice to the Engineer requesting an inspection at least ten (10) days prior to the anticipated inspection date. An area shall be defined by lines of delineation or separation that create individual areas of seeding. The lines of delineation or separation shall include, but are not limited to, project limits, grading limits, edges of pavement, sidewalks, curbs, or driveways, or other limits in accordance with the Contract Documents. A satisfactory stand of grass which is acceptable is defined as consisting of a uniform stand of at least seventy (70) percent established permanent grass species. If an area fails to meet the establishment percentage requirement, the Contractor shall reseed and maintain the area for another sixty (60) day establishment period, and such areas shall be subject to re-inspection and acceptance after such time.

No sodded areas shall be inspected for acceptance prior to thirty (30) days from date of sodding. The Contractor shall submit a written notice to the Engineer requesting an inspection at least ten (10) days prior to the anticipated inspection date. A satisfactory area of sod which is acceptable is defined as consisting of uniform root growth establishment. If an area fails to meet the root growth establishment, the Contractor shall remove, re-sod, and maintain the entire area for another thirty (30) day establishment period, and such areas shall be subject to re-inspection and acceptance after such time.
Acceptance shall include a written request from the Contractor for establishment period commencement, a written request from the Contractor for acceptance inspection, and a written acceptance of seeded areas by the Engineer. The warranty period shall begin at the time of final project completion.

802.05 Measurement and Payment

The Engineer shall measure seeding for payment by the acres of the type of seed installed, ground prepared, fertilized, and accepted. The Contractor shall provide seed tags from each bag of seed supplied and installed.

The Engineer shall measure seeding for payment by the square yards of the type of seed installed, ground prepared, fertilized, and accepted. The Contractor shall provide seed tags from each bag of seed supplied and installed.

The Engineer shall measure mulching for payment by the acres of ground of mulch spread, crimped, and accepted.

The Engineer shall measure mulching for payment by the square yards of ground of mulch spread, crimped, and accepted.

The Engineer shall measure cover crop seeding for payment by the acres of ground seeded and accepted.

The Engineer shall measure cover crop seeding for payment by the square yards of ground seeded and accepted.

The Engineer shall measure hydro seeding for payment by the acres of ground hydro seeded and accepted.

Reseeding or over-seeding to obtain a fully growing area is subsidiary to items for which the Contract provides direct payment. Fertilizer placed in conjunction with seeding is subsidiary to items for which the Contract provides direct payment.

The Engineer shall measure sodding for payment by the square yards of ground prepared, sod supplied, installed, maintained, and accepted.

Payment shall be made under the following unless otherwise indicated in the Contract Documents. The Contract Price shall be full compensation for furnishing and applying fertilizer; furnishing and sowing seed; furnishing and applying mulch materials; preparation of the seedbed; maintaining the seeded areas during the establishment period; furnishing the sod; sod bed preparation; furnishing and applying the pre-emergent and fertilizer; laying the sod and rolling in; supplying and installing stakes; furnishing and applying water; maintaining the sodded areas during the establishment period; and for furnishing all labor, materials, equipment, tools, and all incidentals necessary to complete the work.

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Install Seeding – Type ___</td>
<td>Acre</td>
</tr>
<tr>
<td>Install Seeding – Type ___</td>
<td>Square Yard</td>
</tr>
<tr>
<td>Install Mulching</td>
<td>Acre</td>
</tr>
<tr>
<td>Install Mulching</td>
<td>Square Yard</td>
</tr>
<tr>
<td>Install Cover Crop Seeding</td>
<td>Acre</td>
</tr>
<tr>
<td>Install Cover Crop Seeding</td>
<td>Square Yard</td>
</tr>
<tr>
<td>Install Sodding</td>
<td>Square Yard</td>
</tr>
<tr>
<td>Install Hydro Seeding</td>
<td>Acre</td>
</tr>
</tbody>
</table>
803  Rolled Erosion Control

803.01  General

A. Description

This work includes furnishing and placing erosion control blankets upon the completed side slopes, ditch bottoms, or back-slopes for temporary or permanent erosion control at the locations indicated in the Contract Documents or as directed by the Engineer. Temporary erosion control systems in environmentally sensitive locations shall use biodegradable rolled erosion control products. Permanent erosion control systems shall use non-degradable rolled erosion control products designed for permanent and critical hydraulic applications for which the anticipated discharge velocity or shear stress exceeds the limits of mature, natural vegetation.

B. Submittal Requirements

Refer to Section 800.01 B for submittal requirements.

803.02  Material Requirements

A. General

Material requirements shall be in accordance with the Contract Documents, in addition to the following requirements.

B. Temporary Rolled Erosion Control Products

Rolled erosion control products shall consist of mulch control netting, open weave textiles, erosion control blankets, and turf reinforcement mats. Temporary rolled erosion control shall conform to Table 803.01, including the referenced test procedures.

<table>
<thead>
<tr>
<th>Type</th>
<th>Netting</th>
<th>Material</th>
<th>Longevity</th>
<th>Slope</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type I</td>
<td>Single</td>
<td>Straw</td>
<td>3 Months</td>
<td>1V:3H</td>
</tr>
<tr>
<td>Type II</td>
<td>Double</td>
<td>Straw</td>
<td>12 Months</td>
<td>1V:2H</td>
</tr>
<tr>
<td>Type III</td>
<td>Double</td>
<td>Straw / Coconut</td>
<td>24 Months</td>
<td>1V:1.5H</td>
</tr>
<tr>
<td>Type IV</td>
<td>Double</td>
<td>Coconut</td>
<td>36 Months</td>
<td>1V:1H</td>
</tr>
</tbody>
</table>

Referenced Test Procedures:


Temporary rolled erosion control products shall have either a degradable netting consisting of photodegradable polypropylene, natural and/or polymer fibers; or biodegradable netting consisting of jute or twine with biodegradable thread. Biodegradable netting shall be used in environmentally sensitive areas.
C. Turf Reinforcement Mats

Turf reinforcement mats shall consist of entangled polymer netting, monofilaments, or fibers bonded using polymer welding, thermal or polymer fusion, or positioning between and attaching to two (2) non-degradable polypropylene nets using polyolefin thread. Treat turf reinforcement mats to resist biological, chemical, and ultraviolet degradation. Turf reinforcement mats shall conform to the requirements of Table 803.02, including the referenced test procedures.

<table>
<thead>
<tr>
<th>Type</th>
<th>Maximum Shear Stress</th>
<th>Minimum Tensile Strength</th>
<th>Slope</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type A</td>
<td>6.0 lbs/ft²</td>
<td>125 lbs/ft</td>
<td>1V:0.5H</td>
</tr>
<tr>
<td>Type B</td>
<td>8.0 lbs/ft²</td>
<td>150 lbs/ft</td>
<td>1V:0.5H</td>
</tr>
<tr>
<td>Type C</td>
<td>10.0 lbs/ft²</td>
<td>175 lbs/ft</td>
<td>1V:0.5H</td>
</tr>
</tbody>
</table>

Referenced Test Procedures:

D. Wire Staples

Wire staples shall be made of No. 11 gauge steel wire having a minimum length of six (6) inches. For installations in sand or sandy soils, wire staples shall have a minimum length of twelve (12) inches.

803.03 Construction Requirements

A. General

Perform the work immediately after completing the seeding operations. Seeding operations shall be in accordance with Section 802. The areas receiving rolled erosion control shall be in a smooth, even condition, free of all debris, roots, and stones larger than one (1) inch in diameter. Pulverize, rake out, or remove all lumps of soil. Remove all vegetation from these areas except for the desirable native vegetation that the Contract Documents or the Engineer designates to remain undisturbed.

Place the rolled erosion control or turf reinforcement material in accordance with the Contract Documents, the manufacturer's recommendations, or as directed by the Engineer. Install the rolled erosion control flat and parallel to the flow of water without stretching. Overlap adjacent and subsequent rolled erosion control in accordance with the manufacturer's recommendations but not less than three (3) inches for adjacent sections or twelve (12) inches.
for subsequent sections. Overlap with the downhill and the upslope sections always on top. Anchor the erosion control blanket using wire staples after placing the erosion control blanket. Space the staples in accordance with the manufacturer’s recommendations but not less than three (3) to four (4) feet apart in three (3) rows along each strip, with one (1) row along each edge, and one (1) row alternately spaced in the center. Use one (1) additional row of staples for back-slope and ditch intersection lines. Space staples a maximum of nine (9) inches apart across the width for all ditch anchor folds, splice joints, top of slope anchor folds, and terminations.

Excavate a six (6) inch vertical slot at the top of the slope. Extend the upslope terminal end of the rolled erosion control a minimum of thirty (30) inches past the vertical slot. Place the upper edge of the last upslope section in a six (6) inch vertical slot. Anchor the rolled erosion control material in the slot using staples placed at twelve (12) inch or less intervals. Backfill and compact the slot using soil to anchor the upper portion of the rolled erosion control. Lightly seed the backfill and cover with the rolled erosion control that extends beyond the slot. Staple the overlapped portion down-slope from the vertical trench using staples placed at twelve (12) inch or less intervals. Bury the upstream terminal end of the rolled erosion control as directed by the Engineer. Anchor all other sections of the rolled erosion control in accordance with the manufacturer's recommendations but not less than two (2) staples per square yard.

When directed by the Engineer, lightly seed and rake topsoil across the top of the rolled erosion control to fill any voids in the matting.

### 803.04 Acceptance
The Engineer shall observe the work to check for compliance with the Contract Documents.

### 803.05 Measurement and Payment
The Engineer shall measure in-place rolled erosion controls for payment by the square yards of the type of rolled erosion control furnished, installed, and accepted.

The Engineer shall measure in-place turf reinforcement mats for payment by the square yards of the type of turf reinforcement mat furnished, installed, and accepted.

The Engineer shall measure in-place rolled erosion controls with seeding for payment by the square yards of the type of rolled erosion control and type of seed furnished, installed, and accepted.

Excess material required to satisfy overlap requirements is subsidiary to items for which the Contract provides direct payment.

Payment shall be made under the following unless otherwise indicated in the Contract Documents. The Contract Price shall be full compensation for furnishing, and installing all materials including rolled erosion control, turf reinforcement mat, and anchors; and for furnishing all labor, materials, equipment, tools, and all incidentals necessary to complete the work.

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Install Rolled Erosion Control - Type ___</td>
<td>Square Yard</td>
</tr>
<tr>
<td>Install Turf Reinforcement Mat - Type ___</td>
<td>Square Yard</td>
</tr>
<tr>
<td>Install Rolled Erosion Control - Type ___ with Seeding – Type ___</td>
<td>Square Yard</td>
</tr>
</tbody>
</table>
804 Plant Materials

804.01 General
   A. Description
       This work includes furnishing, collecting, delivering, and planting of plant materials; furnishing
       equipment; moving trees; and resetting trees; and all related operations as required by the
       Contract Documents or as directed by the Engineer. Plant material shall mean trees, shrubs,
       vines, ground cover, and plants of all descriptions required to be furnished for the project in
       accordance with the Contract Documents or as directed by the Engineer.

   B. Submittal Requirements
       Refer to Section 800.01 B for submittal requirements.

       If the Contract Documents do not contain details or plant material requirements, the Contractor
       shall submit to the Engineer a plan, appropriate installation details, and material information
       signed by a Landscape Architect licensed in the State of Nebraska.

804.02 Material Requirements
   A. General
       Material requirements shall be in accordance with the Contract Documents, in addition to the
       following requirements.

   B. Plants
       All plant materials shall be "nursery-grown" unless otherwise indicated in the Contract
       Documents. Package plants in a manner that provides proper protection against freezing,
       drying, breaking, over-heating, or other injury. Use all necessary precautions consistent with
       accepted practices to ensure that the plant materials arrive at the destination in good condition
       for successful growth.

       Wilt-proof all coniferous material before shipment from the source. Remove and replace any
       coniferous material furnished without wilt-proofing at no additional cost to the City. The
       Engineer reserves the right to reject any coniferous materials furnished without the wilt-
       proofing affidavit.

   C. Nursery-Grown Plant Material
       All plant materials shall be in accordance with the American Standard for Nursery Stock
       published by the American Nursery and Landscape Association. All plant material shall comply
       with all applicable local, state, and federal laws, including inspection certifications which shall
       include the project number and the plant material that the certification covers. The City
       reserves the right to allow inspection of any plant material by representatives of the City, State,
       and/or Federal Government. Nursery sourced materials shall be sourced from nurseries in
       similar climates.

       All plant material furnished shall be true to name and type. All plant material shall be sound,
       healthy specimens and first-class representatives of their species or variety, and shall have well-
       formed tops and healthy root systems. Plant materials shall be free from significant defects such
       as girdling roots, root bound, bark damage, topped or co-dominant stems which will not allow
       the plant to develop normally. Immediately remove any rejected plant material from the
       project. Do not injure or remove fibrous roots from the plant material.
Maintain the condition of the soil used for balled, container-grown, or Q-pot-grown material in a manner that prevents crumbling or cracking. Wrap balls with burlap before removing from the ground. Hold the burlap in place using cords or pinning nails. Handle balled and burlapped material in a manner to keep the soil intact. Replace plant material on which the ball has cracked or crumbled at no additional cost to the City.

D. Collected Plant Material

Furnish collected plant material only when specified in the Contract Documents. The Engineer reserves the right to inspect the proposed collected plant material before removal from the existing location. Collected plant material shall be dug in accordance with the applicable portions of the American Standard for Nursery Stock published by the American Nursery and Landscape Association.

E. Transporting Plant Materials

Cover all bare-root stock sent from the storage facility using wet soil, sawdust, wood chips, other moisture-holding media and a tarpaulin or canvas. The Engineer reserves the right to reject any unprotected loads.

F. Fertilizer

Pre-planting fertilizer shall be pressure-formed pellets conforming to the requirements of Table 804.01. Each pellet shall weigh between twenty (20) and twenty-two (22) grams.

<table>
<thead>
<tr>
<th>Property</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Nitrogen (N₂), Minimum Percent</td>
<td>20</td>
</tr>
<tr>
<td>Water Insoluble Nitrogen, Minimum Percent</td>
<td>13</td>
</tr>
<tr>
<td>Available Phosphoric Acid (P₂O₅), Minimum Percent</td>
<td>10</td>
</tr>
<tr>
<td>Water Soluble Potash (K₂O), Minimum Percent</td>
<td>5</td>
</tr>
</tbody>
</table>

Post-planting fertilizer shall be granular fertilizer conforming to the requirements of Table 804.02. Post-planting fertilizer shall contain a pre-emergent for weed control.

<table>
<thead>
<tr>
<th>Property</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Nitrogen (N₂), Minimum Percent</td>
<td>12</td>
</tr>
<tr>
<td>Water Insoluble Nitrogen, Minimum Percent</td>
<td>2.1</td>
</tr>
<tr>
<td>Nitrogen derived from urea formaldehyde, Minimum Percent</td>
<td>25</td>
</tr>
<tr>
<td>Available Phosphoric Acid (P₂O₅), Minimum Percent</td>
<td>4</td>
</tr>
<tr>
<td>Water Soluble Potash (K₂O), Minimum Percent</td>
<td>8</td>
</tr>
<tr>
<td>Allowable Secondary Nutrients</td>
<td>Ca, Mg., S</td>
</tr>
<tr>
<td>Allowable Micro Nutrients</td>
<td>B, Cu, Fe, Mn, Zn</td>
</tr>
</tbody>
</table>
Fertilizer used during the establishment period shall be a liquid urea comprised of twenty-eight (28) to thirty-two (32) percent nitrogen (N₂). Mix the liquid urea with water at a ratio of one (1) part liquid urea to three hundred (300) parts water.

G. Compost

Compost shall consist of granular commercial type peat moss, be dark in color, and have a pH between five and one-half (5.5) and seven and one-half (7.5). Compost shall be in accordance with ASTM D5539, Standard Specification for Seed Starter Mix. Furnish and deliver compost in standard weight bags or bulk.

H. Wood Chip Mulch

Wood chip mulch shall be wood shaving, wood chips, tree bark or shredded bark obtained from mechanical shaving, debarking, or chipping operations of trees. Wood chip mulch shall be reasonably free of insects, disease, debris, seeds, leaves, twigs, sawdust, toxic substances, or other foreign materials.

I. Stakes, Tree Straps, and Guy Wiring

Stakes used for guy wiring shall be wood and approximately one and five-eighth (1\(\frac{5}{8}\)) inch by one and five-eighth (1\(\frac{5}{8}\)) inch. For deciduous trees less than two (2) inches in caliper and coniferous trees less than eight (8) feet in height use stakes with a minimum length of nine (9) inches. For deciduous trees two (2) inches in caliper and larger and coniferous trees eight (8) feet and taller, use stakes with a minimum length of eighteen (18) inches. The guy wires shall be fourteen (14) gauge, soft drawn wire. Tree straps shall be soft polymer webbing with a minimum width of one and one-half (1½) inches and minimum length of six (6) inches with brass grommets at each end, or similar such material. The Engineer reserves the right to accept commercial plant ties in lieu of guy wires.

804.03 Construction Requirements

A. General

Plant deciduous materials between March 1st and May 1st, or between October 1st and December 1st. Plant coniferous materials between March 1st and May 15th, or between August 15th and September 30th. The Contractor may request alternate planting dates, but such requests do not alter any warranty or establishment condition requirements.

The Contractor shall notify the Engineer two (2) days before planting operations begin. The planting locations shall be in accordance with the Contract Documents or as directed by the Engineer. Remove and replace any planted materials that are not true to name at no additional cost to the City.

B. Receiving and Storing Plant Materials

Store all plant materials not planted immediately upon delivery. Storage facilities shall have an adequate water supply, shade, good ventilation, and protection from drying winds. Store all bare-rooted plant materials by dipping in a mud and water slurry immediately upon arrival and before storage. Protect the stored plant materials using wet soil, sawdust, wood chips, or other moisture holding media. Keep stored plant materials well-watered.

Do not remove plant materials from storage before completing the preparation of the planting site for proper and immediate planting. Protect plant materials from freezing, drying, breaking, overheating, and other injuries.
C. Planting

The Contractor shall have all underground utilities (public and private) marked on the ground prior to beginning any plant pit excavations. The Contractor shall stake the location of the proposed trees, shrubs and ground cover plants unless otherwise indicated in the Contract Documents. Trees shall be staked individually. Areas for multiple shrub or ground cover plantings shall be outlined on the ground and the number of plants indicated in some manner without staking the location of individual shrub or ground cover plants.

Prepare the areas to receive planting by tilling any existing vegetation into the soil to a minimum depth of two (2) inches. Excavate the hole for the plant material in the tilled area to the dimensions indicated in the Contract Documents. Trees shall be planted in holes that are at least three (3) times as wide as the diameter of the ball or container and of a depth equal to the ball or container height. Burlap and tying material shall be removed as much as possible from the root ball without damaging the roots or the root ball. Treated burlap shall be removed from the root ball. Wire baskets shall be removed from the root ball without damaging the roots or the root ball.

Place pre-planting fertilizer in the excavated hole in a manner and location that will avoid direct contact with the root system. Use three (3) pellets per plant for all shrubs and vines. Use eight (8) pellets per plant for all trees less than two (2) inches in caliper or less than eight (8) feet in height. Use ten (10) pellets per plant for all trees two (2) inches in caliper or larger or eight (8) feet or greater in height.

Position the plant material vertically. Place balled and burlapped material in a manner that prevents the ball from cracking and pulling away from the roots. The Engineer reserves the right to reject damaged balled and burlapped materials.

Remove and reset trees using a mechanical tree spade and having a manufacturer's size rating equal to or exceeding the tree sizes.

Place compost as indicated in the Contract Documents.

When backfilling balled and burlapped plant material, remove all twine from the trunk and pull the burlap away from the trunk before completing the backfilling operation. When backfilling bare-rooted plant material, examine the roots and cleanly prune any bruised or broken roots. Accomplish backfilling with care to avoid breaking, bruising, or otherwise damaging the roots or other parts of the plant materials when firming the soil. Construct a watering basin for all plant material. Scatter and level any surplus material from the excavation to leave a neat, smooth appearance. Fill the water basin with water before installing the post-planting fertilizer.

Place post-planting fertilizer with a pre-emergent before placing the mulch. Place one-half (½) pound per plant for all shrubs and vines. Place one (1) pound per plant for all trees less than two (2) inches in caliper or less than eight (8) feet in height. Place two (2) pounds per plant for all trees two (2) inches in caliper or larger or eight (8) feet or greater in height.

Carefully place wood chip mulch in a manner that avoids harming any plant materials within the prepared area. Place wood chip mulch a minimum of four (4) inches thick in a manner that covers the entire ground. Place wood chip mulch four (4) inches deep across all disturbed earth or as directed by the Engineer. Apply the mulch after completing the post-planting fertilizer application and placement of drain tile trunk protectors. Do not place mulch around the trunks of trees.
Construct tree rings, and stake and guy all trees in accordance with Standard Plate 804-01 or as indicated in the Contract Documents. Tree ring construction is subsidiary to items for which the Contract provides direct payment. Drive the stakes so that they are firm and provide support to the trees. Do not penetrate the ball or roots of the trees with the stakes. Install guys sufficiently tight to transfer support from stake to tree.

Water-in all planted plant material within two (2) hours of installation. Cease planting operations until watering is current when watering fails to meet the specified time limit. Maintain the plant materials in a moist condition as dictated by weather conditions, soil conditions, or as directed by the Engineer until the establishment period commences.

An experienced pruner shall properly and systematically prune all deciduous plant materials. Perform pruning using the process of thinning to maintain and preserve the characteristic shape and natural form of the plant material as indicated in the Contract Documents. Paint any cut surfaces greater than one (1) inch in diameter with a standard pruning compound. Dispose of all cuttings removed by pruning.

D. Establishment Period

The Contractor shall request the commencement of the establishment period. The establishment period will not begin until completion of all proper planting, backfilling, fertilizing, watering, pruning, wrapping, staking, guying, water basin construction, and mulching required in the Contract Documents on every plant material. All plant material shall be in an acceptable growing condition when the project enters the establishment period. The establishment period shall last until June 1st of the following year. The City reserves the right to extend the establishment period by one (1) additional year for failure to maintain the plant material as required by the Contract Documents. Replace all unacceptable plant material in the spring planting season. All replacement plant material shall receive a minimum of thirty (30) days establishment period before final acceptance.

During the establishment period, maintain all plant materials planted under the Contract. Maintenance includes, but is not limited to, additional pruning, pest and disease prevention and treatment, watering a minimum of every ten (10) days, fertilizing, cultivating, watering basin repair, mulch replacement, stakes and guys adjustment, weeding, weed treatment, and other establishment procedures. Accomplish weed treatment using a pre-emergent weed control or other similar means. Between March 1st and June 1st of the year following the year of planting the plant materials, fertilize all trees and shrubs.

E. Warranty

All plants and their subsequent replacements shall be guaranteed for a minimum of two (2) years from the date of initial acceptance. The Contractor shall be responsible for removing and replacing any plant that is dead or not in satisfactory growth as determined by the Engineer. Plant material replacements shall be replaced during the normal planting season as described in Section 804.03A. Replacements shall be plants of the same kind and size as indicated in the Contract Documents. Replacement plants shall be guaranteed for two (2) years from their date of initial acceptance. Replacements shall be performed at no additional cost to the City.

804.04 Acceptance

Before planting, inspect the plants and root balls for cracks or other damage. Damaged plants include any plant with a defect that materially affects the plant’s ability to survive and grow as intended. Damaged plants shall not be installed and shall be removed from the site and replaced at
the Contractor’s expense. The Engineer shall observe the work to check for compliance with the
Contract Documents.

No plants shall be inspected for acceptance prior to June 1st following the date of planting. The
Contractor shall submit a written notice to the Engineer requesting an inspection at least ten (10)
days prior to the anticipated inspection date. A satisfactory plant which is acceptable is defined as
showing evidence of growth. If a plant fails to show growth, the Contractor shall remove, re-plant,
and maintain the plant for another thirty (30) day establishment period, and such plant(s) shall be
subject to re-inspection and acceptance after such time. The Contractor shall remove staking after
acceptance of the plants.

Acceptance shall include a written request from the Contractor for establishment period
commencement, a written request from the Contractor for acceptance inspection, and a written
acceptance of all plant material by the Engineer. The warranty period shall begin at the time of final
project completion.

804.05 Measurement and Payment

The Engineer shall measure plant materials for payment by the type of each plant item furnished,
planted, mulched, and accepted.

The Engineer shall measure removing and resetting trees for payment by each tree removed, reset,
mulched, and accepted.

The Engineer shall measure compost bags for payment by each fifty (50) pound bag supplied,
installed, and accepted.

The Engineer shall measure bulk compost for payment by the tons of bulk compost supplied,
installed, and accepted. The Engineer shall determine tonnage based upon certified load tickets
collected at the time of delivery that identify the source of the bulk compost, the date, the
Contractor, the project number, the tare weight of the transport vehicle, and the weight of the
material delivered in tons. Accomplish all weighing using certified scales. The Engineer reserves the
right to verify the ticketed weight. Weigh all materials delivered using rail cars or other bulk
methods less any wasted tonnage using a certified scale at no additional cost to the City.

When indicated in the Contract Documents, the Engineer shall measure wood chip mulch for
payment by the cubic yards of wood chip mulch supplied, installed, and accepted.

Payment shall be made under the following unless otherwise indicated in the Contract Documents.
The Contract Price shall be full compensation for supplying, installing, fertilizing, placing wood chip
mulch, staking, guying, water basin preparation, watering, pruning, and maintaining planted
materials during the establishment period; and for furnishing all labor, materials, equipment, tools,
and all incidentals necessary to complete the work.

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Install ___ Plant Material</td>
<td>Each</td>
</tr>
<tr>
<td>Remove And Reset Tree</td>
<td>Each</td>
</tr>
<tr>
<td>Install Compost ___ Bags</td>
<td>Each</td>
</tr>
<tr>
<td>Install Compost Bulk</td>
<td>Ton</td>
</tr>
<tr>
<td>Install Wood Chip Mulch</td>
<td>Cubic Yard</td>
</tr>
</tbody>
</table>
805    Rock Rip Rap

805.01    General
A.    Description
This work includes preparing slopes and furnishing and constructing crushed aggregate rip rap in accordance with the Contract Documents or as directed by the Engineer.

B.    Submittal Requirements
Refer to Section 800.01 B for submittal requirements.

805.02    Material Requirements
A.    General
Material requirements shall be in accordance with the Contract Documents, in addition to the following requirements.

B.    Stone and Crushed Aggregate
Evaluate aggregate in accordance with ASTM D4992, Standard Practice for Evaluation of Rock to be Used for Erosion Control. Do not use aggregate having a length to width, length to height, or width to height ratio greater than 3:1. Perform petrographic analysis only when requested by the Engineer. Aggregate shall be sandstone, limestone, quartzite, or other hard stone of good quality that is free of earth, clay, or refuse. The solid rock shall have a density of at least one-hundred forty (140) pounds per cubic foot.

Aggregate physical property characteristics shall conform to the requirements of Tables 805.01 and 805.02. Each load of rock shall be reasonably well graded from the largest to the smallest size specified. Control of gradation shall be by visual inspection to verify that the aggregate is reasonably well graded and conforms to the maximum, mean, and minimum weights as specified. The aggregate shall be angular in shape to permit interlocking between the various rock sizes. Process the aggregate to meet the size requirements defined by the Contract Documents and determined in accordance with ASTM D6092, Standard Practice for Specifying Sizes of Stone for Erosion Control.

Table 805.01
Physical Property Requirements

<table>
<thead>
<tr>
<th>Physical Property</th>
<th>Acceptable Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium Sulfate Soundness, (5 cycles)*</td>
<td>10.0% maximum loss</td>
</tr>
<tr>
<td>Magnesium Sulfate Soundness, (5 cycles)*</td>
<td>15.0% maximum loss</td>
</tr>
<tr>
<td>Freeze-Thaw Soundness, (25 cycles)*</td>
<td>15.0% maximum loss</td>
</tr>
<tr>
<td>LA Abrasion, ASTM C131 and ASTM C535</td>
<td>40.0% maximum loss</td>
</tr>
<tr>
<td>Bulk Specific Gravity</td>
<td>2.40 minimum</td>
</tr>
<tr>
<td>Absorption, ASTM C127 and ASTM C128</td>
<td>3.0% maximum</td>
</tr>
</tbody>
</table>

*Only one of the three soundness requirements must be fulfilled.
### Table 805.02

**Gradation Requirements**

<table>
<thead>
<tr>
<th>Type of Rip Rap</th>
<th>Size of Individual Rocks (pounds)</th>
<th>Percentage of Total Delivery of Rock Smaller Than the Given Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type A</td>
<td>150</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td>35</td>
<td>50%</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Not to exceed 10%</td>
</tr>
<tr>
<td>Type B</td>
<td>300</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td>80</td>
<td>50%</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Not to exceed 10%</td>
</tr>
<tr>
<td>Type C</td>
<td>700</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td>150</td>
<td>50%</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>Not to exceed 10%</td>
</tr>
</tbody>
</table>

### 805.03 Construction Requirements

**A. Delivery of Materials**

The quarry shall issue tickets to the driver for each load of rip rap delivered to the project. Each ticket shall include the name of the producer, the date, the location of the quarry, the quantity delivered (in tons), the name of the Contractor and the project number. The ticket shall be given to the Engineer at the time of arrival at the placement site. When any shipment’s weight has not been documented, the Contractor shall measure the rock on certified scales at the Contractor’s expense and in the presence of the Engineer.

**B. Placement**

Excavate as required in the Contract Documents before placing aggregate. The finished subgrade shall conform to the lines, grades and slopes as indicated in the Contract Documents. All depressions shall be filled and compacted with borrow material in accordance with Section 200. Unsuitable materials shall be removed and replaced in accordance with Section 200. No raised places, bumps, or depressions will be allowed. Install geotextile fabric in accordance with Section 300. Place the aggregate in a manner that produces a reasonably uniform layer and solid mass of rip rap within the limits indicated in the Contract Documents. The Contractor shall perform compaction efforts using mechanical methods.

### 805.04 Acceptance

The Engineer shall observe the work to check for compliance with the Contract Documents. Subgrade shall be constructed to the minimum compaction requirements identified in the Contract Documents. The Engineer shall verify the compaction of the subgrade in accordance with the City of Omaha Materials and Testing Manual for Public Works Construction.

### 805.05 Measurement and Payment

When indicated in the Contract Documents, the Engineer shall measure rip rap for payment by the tons of the type of rip rap supplied, placed, and accepted. The Engineer shall determine tonnage based upon certified load tickets collected at the time of delivery. Geotextile fabric shall be considered subsidiary to other items for which direct payment is made.
Payment shall be made under the following unless otherwise indicated in the Contract Documents. The Contract Price shall be full compensation for furnishing, preparing, weighing, additional pulverizing, loading, hauling, and placing all materials; all other excavation, backfilling and fine grading; and for furnishing all labor, materials, equipment, tools, and all incidentals necessary to complete the work.

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construct Type</td>
<td>Ton</td>
</tr>
<tr>
<td>___ Rip-Rap</td>
<td></td>
</tr>
</tbody>
</table>
806 Gabion Baskets and Revet Mattresses

806.01 General
   A. Description
       This work includes furnishing, assembling, tying, and filling with approved stones, wire mesh
gabion baskets, or revet mattresses constructed and placed along the lines, grades, dimensions,
and details indicated in the Contract Documents or as directed by the Engineer.

   B. Submittal Requirements
       Refer to Section 800.01 B for submittal requirements.

806.02 Material Requirements
   A. General
       Material requirements shall be in accordance with the Contract Documents, in addition to the
   following requirements.

   B. Basket and Mattress Fill Material
       Fill material for gabion baskets or revet mattresses shall be limestone or quartzite, free of earth,
clay, or refuse, that does not disintegrate under action of air or water. Evaluate aggregate in
accordance with ASTM D4992, Standard Practice for Evaluation of Rock to be Used for Erosion
Control. Use the same type of fill material for all baskets, not a combination of one (1) or more
fill materials. The size of the stone for gabion baskets shall be four (4) inches to eight (8) inches
in diameter. The size of the stone for revet mattresses shall be three (3) inches to six (6) inches
in diameter. The maximum length of stone shall not exceed sixteen (16) inches. The maximum
weight for any one stone shall not exceed six (6) pounds.

       Fill material for gabion baskets or revet mattresses shall conform to the requirements of Table
806.01. Ship the fill material in a manner that avoids segregation. The fill material shall be
angular in shape to permit interlocking between the various rock sizes.

<table>
<thead>
<tr>
<th>Physical Property</th>
<th>Acceptable Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium Sulfate Soundness, (5 cycles)*</td>
<td>10.0% max. loss</td>
</tr>
<tr>
<td>Magnesium Sulfate Soundness, (5 cycles)*</td>
<td>15.0% max. loss</td>
</tr>
<tr>
<td>Freeze-Thaw Soundness, (15 cycles)*</td>
<td>15.0% max. loss</td>
</tr>
<tr>
<td>LA Abrasion, ASTM C131 and ASTM C535</td>
<td>40.0% max. loss</td>
</tr>
<tr>
<td>Bulk Specific Gravity</td>
<td>2.40 min.</td>
</tr>
<tr>
<td>Absorption, ASTM C127 and ASTM C128</td>
<td>3.0% max.</td>
</tr>
</tbody>
</table>

*Only one of the three soundness requirements must be fulfilled.

   C. Geotextile Fabric
       Geotextile fabric shall be in accordance with Section 300.

   D. Wire Mesh Baskets
       Wire mesh baskets shall be in accordance with ASTM A974, Standard Specification for Welded
Wire Fabric Gabions and Gabion Mattresses (Metallic-Coated or Polyvinyl Chloride (PVC)
Coated). Double-twisted hexagonal mesh baskets shall be in accordance with ASTM A975,
Standard Specification for Double-Twisted Hexagonal Mesh Gabions and Revet Mattresses (Metallic-Coated Steel Wire or Metallic-Coated Steel Wire With Poly(Vinyl Chloride) (PVC) Coating). Coat all wire with a zinc coating followed by a polyvinyl chloride coating.

806.03 Construction Requirements

A. Excavation and Grading

Excavate the area to the lines and grades indicated in the Contract Documents, in accordance with Section 200. Grade and compact areas to receive gabion baskets or revet mattresses to the lines and grades indicated in the Contract Documents or as directed by the Engineer. Compact fill areas to a minimum of ninety-five (95) percent of the maximum dry density in accordance with ASTM D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort. Slopes shall be a smooth plane surface. Re-grade or remove all slope deformities, roots, grade stakes, stones, and any holes, equipment tracks, or other voids deeper than one (1) inch.

B. Assembly and Installation

Remove all kinks and bends from the unassembled gabion baskets or revet mattresses before assembly. Assemble each unit individually in accordance with the manufacturer’s recommendations. Install fasteners and additional connections in accordance with the manufacturer’s recommendations. The maximum spacing between fasteners shall be four (4) inches, or the manufacturer’s recommendations, whichever is less.

Place the assembled baskets or mattresses at the location(s) indicated in the Contract Documents or directed by the Engineer without damaging or otherwise altering the shape of the baskets or mattresses. Secure abutting baskets in all directions. Cut, fold, and connect any surplus mesh from custom-sized baskets to an adjacent gabion basket face.

Fill lower tier baskets before placing and securing upper tier baskets. Fill the gabion baskets or revet mattresses with fill material in a manner that maintains the required alignment, avoids bulges, minimizes the amount of internal voids, and avoids damaging the PVC coating on the wires. Place fill material in a maximum lift thickness of one (1) foot. Fill adjacent baskets and mattresses simultaneously. Hand place all fill material on the exposed faces of the gabion baskets or revet mattresses to provide a tight, neat, aesthetic appearance. Overfill the basket or mattress approximately two (2) inches above the sides before closing the lid. Secure the lid to the sides, ends, and diaphragms in accordance with the manufacturer’s recommendations. Bend all projections or wire ends toward the center of the basket or mattress.

C. Backfill

Backfill and compact gabion baskets flush with the top of each tier in accordance with Section 200 before placing the next successive tier. Backfill and compact revet mattresses flush with the top of the mattress.

806.04 Acceptance

The Engineer shall observe the work to check for compliance with the Contract Documents.

Subgrade shall be constructed to the minimum compaction requirements identified in the Contract Documents. The Engineer shall verify the compaction of the subgrade in accordance with the City of Omaha Materials and Testing Manual for Public Works Construction.
806.05 Measurement and Payment

The Engineer shall measure gabion baskets for payment by the cubic yards of gabion basket and rock fill material supplied, constructed, and accepted.

The Engineer shall measure revet mattresses for payment by the cubic yards of revet mattress and rock fill material supplied, constructed, and accepted.

Payment shall be made under the following unless otherwise indicated in the Contract Documents. The Contract Price shall be full compensation for excavating, grading and compacting; supplying, assembling, and placing all baskets and mattresses; furnishing and placing all fill material; backfilling; and for furnishing all labor, materials, equipment, tools, and all incidentals necessary to complete the work.

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construct Gabion Basket</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>Construct Revet Mattress</td>
<td>Cubic Yard</td>
</tr>
</tbody>
</table>
807  Fence

807.01  General

A. Description

This work includes furnishing materials for, and the erection of, fence, including gates, fence terminals, concrete foundations, and other appurtenances, at the locations indicated in the Contract Documents.

B. Submittal Requirements

Refer to Section 800.01 B for submittal requirements.

807.02  Material Requirements

A. General

Material requirements shall be in accordance with the Contract Documents, in addition to the following requirements.

B. Metal Chain Link Fence Materials

All fence fabric furnished under the Contract shall be of the same type. Tie wires shall be either zinc-coated steel tie wire, aluminum-coated steel tie wire, or aluminum alloy tie wire. All tie wire furnished under the Contract shall be of the same type. Metal chain link fence materials shall be in accordance with the applicable sections of the following:

- ASTM F668, Standard Specification for Poly(Vinyl Chloride) (PVC) and Other Organic Polymer-Coated Steel Chain-Link Fence Fabric.
• ASTM F1664, Standard Specification for Poly(Vinyl Chloride) (PVC)-Coated Steel Tension Wire Used with Chain-Link Fence.
• ASTM F1665, Standard Specification for Poly(Vinyl Chloride) (PVC)and Other Conforming Organic Polymer-Coated Steel Barbed Wire Used With Chain-Link Fence.

Chain link fabric shall be woven in a two (2) inch diamond mesh. The top selvage shall be twisted and barbed and the bottom selvage shall be twisted and barbed or knuckled. Gate fabric shall be of the same type, size of mesh, gauge size of wire and selvage as that specified for fence. Latches, hinges, stops, and gatekeepers shall be galvanized steel. Single gate latches shall be fork type, gravity drop bar type with positive locking features, or plunger bar type of full gate height. Provide gatekeepers for each gate leaf over five (5) feet wide. Gatekeepers shall consist of a mechanical device for securing the free end of the gate when in full open position. Hinges shall allow the gate leaf to swing a minimum of ninety (90) degrees in each direction.

C. Wood Fence Materials
Wood fence materials shall be in accordance with ASTM F537, Standard Specification for Design, Fabrication, and Installation of Fences Constructed of Wood and Related Materials.

D. PVC Fence Materials
PVC fence materials shall be in accordance with ASTM F964, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Exterior Profiles Used for Fencing.

E. Wrought Iron Fence Materials
Wrought iron fence materials shall be in accordance with ASTM A702, Standard Specification for Steel Fence Posts and Assemblies, Hot Wrought.

F. Ornamental Fence Materials
Ornamental fence materials shall be in accordance with the applicable sections of the following:
• ASTM A653, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
• ASTM D822, Standard Practice for Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings.
• ASTM D1654, Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments.
• ASTM D2244, Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates.
• ASTM D3359, Standard Test Methods for Rating Adhesion by Tape Test.

Steel material for fence panels and posts shall have a minimum yield strength of forty-five thousand (45,000) pounds per square inch (psi) and a minimum zinc (hot-dip galvanized) coating weight of nine-tenths (0.9) ounces per square foot (oz/sf) with a coating designation of G-90.

Material for pickets shall be a minimum of one (1) inch square using fourteen (14) gauge tubing. Rails shall be steel channel with minimum dimension of one and three-fourths (1.75) inches by one and three-fourths (1.75) inches by one-tenth (0.1) inches. Picket holes in the rail shall be spaced four and three-fourths (4.75) inches on center. For fence systems up to and including six (6) feet tall, posts shall be a minimum of two and one-half (2.5) inches square and twelve (12) gauge thickness.

Pickets, rails, and posts shall be pre-cut to specified lengths. Rails shall be pre-punched to accept pickets. Pickets shall be inserted into the pre-punched holes in the rails and shall be aligned to standard spacing using a specially calibrated alignment fixture. The aligned pickets and rails shall be joined at each picket-to-rail intersection by fusion welding process or of equal quality process, thus completing the rigid panel assembly (note: the process produces a virtually seamless, spatter-free good-neighbor appearance, equally attractive from either side of the panel). The manufactured panels shall be subjected to an inline electrodeposition coating process consisting of a multi-stage pretreatment/wash (with zinc phosphate), followed by a duplex application of an epoxy primer and an acrylic topcoat. The minimum cumulative coating thickness of epoxy and acrylic shall be two (2) mils. The color shall be black. The manufactured fence system shall be capable of meeting the vertical load, horizontal load, and infill performance requirements for industrial weight fences in accordance with ASTM F2408, Standard Specification for Ornamental Fences Employing Galvanized Steel Tubular Pickets. Swing gates shall be fabricated using one and three-fourths (1.75) inch by fourteen (14) gauge forerunner double channel rail, two (2) inch by twelve (12) gauge square ends, and one (1) inch by fourteen (14) gauge pickets. Gates that exceed six (6) feet in width shall have a one and three-fourths (1.75) inch by fourteen (14) gauge square intermediate upright. All rail and upright intersections shall be joined by welding. All picket and rail intersections shall also be joined by welding. Gusset plates will be welded at each upright to rail intersection. Cable kits shall be provided for additional trussing for all gate leaves over six (6) feet. Pedestrian swing gates shall be self-closing, having a gate leaf no larger than forty-eight (48) inches wide. Integrated hinge-closer set (two quantity) shall be Americans with Disabilities Act (ADA) compliant that shall include a variable speed and final snap adjustment with compact design (no greater than five (5) inches by six (6) inches footprint). Hinge-closer set (two quantity) shall be tested to a minimum of five-hundred thousand (500,000) cycles and capable of self-closing gates up to a maximum gate weight of two-hundred sixty (260) pounds and maximum weight load capacity of one-thousand five-hundred (1,500) pounds. Hinge-closer device shall be externally mounted with tamper-resistant security fasteners, with full range of adjustability, horizontal (one half (0.5) to one and three-eights (1.375) inches) and vertical (zero (0) to one-half (0.5) inches). Maintenance free hinge-closer set shall be tested to operate in temperatures of negative twenty (-20) degrees Fahrenheit to two-hundred (200) degrees Fahrenheit, and swings to negative two (-2) degrees to provide reliable final lock engagement.

G. Concrete

Concrete shall be in accordance with Section 500.
H. Copper Grounding Wire and Grounding Rod
Copper grounding wire shall be No. 6 AWG stranded copper wire in accordance with ASTM B3, Standard Specification for Soft or Annealed Copper Wire. Grounding rods and test stakes shall be in accordance with IMSA Specification Number 62-1956 excluding length and diameter requirements. Ground rods and test stakes shall have a minimum diameter of five-eighth ($\frac{5}{8}$) inch. Supply ground rods and test stakes with a ground rod clamp.

I. Bollards
Bollards shall be squared or rounded wood, cast aluminum, squared or rounded PCC-filled metal pipes, or collapsible as indicated in the Contract Documents.

J. Safety Fence
Safety fence shall be orange plastic fence with a minimum one-tenth (0.1) inch thickness.

K. Steel T-Posts
Steel T-Posts for safety fence shall be in accordance with ASTM A702, Standard Specification for Steel Fence Posts and Assemblies, Hot Wrought.

807.03 Construction Requirements

A. General
Confine all operations to areas within the Right-of-Way or easement limits. Grade the fence line to remove irregular projections or depressions and allow the fence to conform to the general contour of the ground. Limit grading operations to within two (2) feet of the fence line unless otherwise directed by the Contract Documents or the Engineer. Perform grading operations with minimum disturbance to the terrain outside the fence line.

All fence posts shall be embedded in PCC footings, or installed integrally with PCC structures. Galvanized metal or PVC sleeves may be used when constructing a fence in a PCC structure. Fill any void between such fence posts and the sleeve using a non-shrink grout or PCC. Construction of PCC footings or sleeves shall be considered subsidiary to other items for which the Contract provides direct payment. When constructing fence parallel to Right-of-Way lines, erect the fence posts centered on the Right-of-Way line. Install fence posts plumb and true to the lines, grades, and elevations indicated in the Contract Documents. Adjust post spacing at fence breaks or at connections to existing fences.

Install materials on posts after the PCC footings have sufficiently hardened. Position the fence to follow the ground contour with the bottom of the fence not more than two (2) inches above the ground. Attach the fence on the street side of the posts unless otherwise directed by the Contract Documents or the Engineer.

B. Gates
Thoroughly clean welded connections on gate frames using a wire brush. Remove traces of the welding flux and any loose or cracked smelter. Paint the cleaned areas with two coats of zinc-oxide paint. Provide a PCC footing for drop-bar-locking devices on double gates. Make a hole using a galvanized metal or PVC sleeve to receive the locking bar to the depth specified by the manufacturer of the locking device. Hinge each single gate to prevent removal of the gate without tools. Set the gate in an approximately horizontal plane. Set the gate so it swings freely inward and outward and fastens securely in its latch holder or, in the case of double gates, in its latch holder and gate stops. Set double gates on their respective hinge pintles to provide a
common horizontal plane in which each single gate swings. Set gates to swing open a minimum of ninety (90) degrees in each direction.

C. **Grounding**

When a power line runs parallel to and above the fence, the fence shall be grounded at intervals of two thousand (2,000) feet, and at end or gate posts. When a power line crosses over the fence, the fence shall be grounded at the point where the power line crosses it. The ground rod shall extend a minimum of six (6) inches below the finished ground elevation and a minimum of eight (8) vertical feet beneath the bottom of the fence. Install the ground rod in accordance with NEC Article 250. Connect the grounding rod to each fence element using a No. 6 AWG stranded copper wire connected by brazing or non-corrosive fastening clamps.

D. **Chain Link Fence Installation**

Install all chain-link fencing in accordance with Standard Plate 807-01 and ASTM F567, Standard Practice for Installation of Chain-Link Fence. Construct takedown panels and gates at the locations indicated in the Contract Documents. End or corner posts shall be installed at all fence intersections or when joining an existing fence.

Tubular line posts shall have heavy malleable iron caps to hold the top rail and exclude moisture from inside the post. "H" Section steel line posts shall be constructed or equipped with a suitable device to hold the top rail. All end, corner, gate, and pull posts shall be furnished with braces, truss rods, turnbuckles, tension bands, and all fittings required to make complete installation as indicated in the Contract Documents. Join rolls of fabric by weaving a single strand into the ends of the rolls to form a continuous mesh. Fasten fabric to the end bars of the gate frame by stretcher bars and fabric bands. Stretch the fence material using mechanical fence stretchers of sufficient capacity and design for such use. Firmly attach fence fabric to the posts and brace, tauten, and install to required elevations. Use a minimum of six (6) equally spaced fasteners to fasten the fabric to each ten (10) feet of rail. Use a minimum of one (1) fastener every twelve (12) inches to fasten the fabric to posts.

E. **Wood Fence Installation**


F. **PVC Fence Installation**


G. **Ornamental Fence**

Fence shall be fabricated in accordance with the manufacturer’s recommendations and procedures, unless otherwise indicated in the Contract Documents. Install ornamental fencing in accordance with the manufacturer’s recommendations. Sleeves shall be installed in retaining walls and shall be considered subsidiary to other items for which the Contract provides direct payment. Gate posts shall be spaced in accordance with the Contract Documents. Fence posts shall be spaced in accordance with the manufacturer’s recommendations and shall be set in concrete foundations to a minimum depth of thirty-six (36) inches. For installations that require raking to follow sloping grades, the post spacing dimension shall be measured along the grade. Fence panels shall be attached to posts with brackets provided by the manufacturer. Posts installed by other methods, including but not limited to plates or grouted core-drilled foundations, shall not be acceptable unless otherwise directed by the Engineer.
H. Bollards

Drill holes for metal bollards at the locations indicated in the Contract Documents. The minimum diameter of the drilled hole shall be six (6) inches greater than the maximum cross-sectional diameter of the bollard. Set the bollards plumb and backfill using PCC to a minimum of two (2) inches above the surrounding ground. Dome the top of the PCC during finishing unless otherwise indicated in the Contract Documents. Wood bollards shall be installed in such a manner as to minimize surrounding soil disturbance. Collapsible bollards shall be installed in accordance with the manufacturer’s recommendations.

I. Temporary Security Fence

Temporary security fence shall be chain link fence that is either seventy-two (72) or ninety-six (96) inches in height, unless otherwise indicated in the Contract Documents. Install temporary security fence and gates in locations indicated in the Contract Documents or as directed by the Engineer. The temporary security fence shall be placed and secured in such a manner as to protect the site and guard against entry by persons unaware of site conditions. The Contractor shall install a top tension wire or top rail as part of the temporary security fence. Maintenance and removal of temporary security fence and gates at the completion of the project, and restoration of the surrounding ground, shall be considered subsidiary to other items for which direct payment is made.

J. Temporary Safety Fence

Temporary safety fence shall be plastic orange snow fence unless otherwise indicated in the Contract Documents. Install temporary safety fence in locations indicated in the Contract Documents or as directed by the engineer. The temporary safety fence shall be placed and secured in such a manner as to protect the site and guard against entry by persons unaware of site conditions. Maintenance and removal of temporary safety fence at the completion of the project, and restoration of the surrounding ground, shall be considered subsidiary to other items for which direct payment is made.

807.04 Acceptance

The Engineer shall observe the work to check for compliance with the Contract Documents. Concrete shall be constructed to the minimum compressive strength requirements identified in the Contract Documents. The Engineer shall verify the compressive strength of the concrete in accordance with the City of Omaha Materials and Testing Manual for Public Works Construction.

807.05 Measurement and Payment

The Engineer shall measure fences for payment by the linear feet of the type and size of fence supplied, constructed, and accepted, excluding any lengths for takedown panels and gates. The Engineer shall measure fence along the bottom of the fence from center of post to center of post.

The Engineer shall measure gates for payment by the type and size of each gate supplied, constructed, and accepted.

The Engineer shall measure bollards for payment by the type and size of each bollard supplied, constructed, and accepted.

The Engineer shall measure temporary security fence for payment by the linear feet of the height of fence supplied, constructed, removed, and accepted.

The Engineer shall measure temporary safety fence for payment by the linear feet of fence supplied, constructed, removed, and accepted.
Payment shall be made under the following unless otherwise indicated in the Contract Documents. The Contract Price shall be full compensation for site preparation, excavation, backfilling, furnishing and installing all footings, materials, fittings, fence fabric, and posts; installing electrical grounding wire and rods; and for furnishing all labor, materials, equipment, tools, and all incidentals necessary to complete the work.

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construct ___ Fence</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Construct ___ Fence Gate</td>
<td>Each</td>
</tr>
<tr>
<td>Construct ___ Bollard</td>
<td>Each</td>
</tr>
<tr>
<td>Construct Temporary Security Fence ___”</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Construct Temporary Safety Fence</td>
<td>Linear Foot</td>
</tr>
</tbody>
</table>
SECTION 900 – TRAFFIC CONTROL

900 Traffic Control

900.01 General

A. Description
The information, submittal requirements, material requirements, and construction requirements shall apply to all subsections within Section 900 unless otherwise specified. This section includes traffic controls, foundations, poles, mast arms, luminaires, traffic signals and controllers, electrical cable and duct, pavement markings, traffic control devices, service disconnects, vehicle detectors, modular video vehicle detection systems, and preemption control systems.

B. Submittal Requirements
Before ordering materials and within fifteen (15) calendar days after the award date, submit the information required below for all materials. The Contractor shall be liable for any materials purchased before receiving written approval from the Engineer. Use new, unused, and in first class condition materials for the construction of the traffic control system unless otherwise indicated in the Contract Documents. Each submittal shall identify in writing any deviations from the requirements of the Contract Documents. The Contractor shall submit, in accordance with the General Conditions, the following submittals:

1. General
   a. Licensed electrician name and license number.
   b. Fabricator’s qualifications and experience.
   c. Welder certifications or proof of ability to weld structural steel.
   d. Pre-qualifications of proposed welding procedures for welds made in the field.

2. Poles, Mast Arms, and Cantilever Structures
   a. Metal poles material certifications and mill tests, design calculations, working drawings, and manufacturer’s installation recommendations.
   b. Metal pole foundations design calculations, working drawings, and manufacturer’s installation recommendations for mast arm lengths greater than sixty-five (65) feet.
   c. Mast arms material certifications and mill tests, design calculations, working drawings, and manufacturer’s installation recommendations.
   d. Pedestal poles material certifications and mill tests, design calculations, working drawings, and manufacturer’s installation recommendations.
   e. Anchor bolts material certifications and mill tests, design calculations, working drawings, and manufacturer’s installation recommendations.
   f. Breakaway devices material certifications and mill tests, design calculations, working drawings, and manufacturer’s installation recommendations.
   g. Wire and cable material certifications, working drawings, and manufacturer’s installation recommendations.
h. Conduit material certifications, working drawings, and manufacturer’s installation recommendations.

i. Wood poles material certifications and product data, design calculations, working drawings, and manufacturer’s installation recommendations.

j. Wood pole fittings material certifications, working drawings, and manufacturer’s installation recommendations.

k. Pole guys and hardware material certifications, working drawings, and manufacturer’s installation recommendations.

l. Guy anchors material certifications, working drawings, and manufacturer’s installation recommendations.

3. Traffic Signals
   a. Traffic signals material certifications, working drawings, and manufacturer’s installation recommendations.

   b. Optically programmed traffic signals material certifications, working drawings, and manufacturer’s installation recommendations.

   c. LED signal indicators material certifications, working drawings, and manufacturer’s installation recommendations.

   d. Pedestrian signals material certifications, working drawings, and manufacturer’s installation recommendations.

   e. Mounting hardware material certifications, working drawings, and manufacturer’s installation recommendations.

   f. Electrical cable material certifications, working drawings, and manufacturer’s installation recommendations.

   g. Pedestrian push buttons material certifications, and manufacturer’s installation recommendations.

   h. Conduit material certifications, and manufacturer’s installation recommendations.

   i. Splice boxes material certifications, and manufacturer’s installation recommendations.

4. Traffic Signal Controllers
   a. System memory module material certifications and mill tests, design calculations, working drawings, and manufacturer’s installation recommendations.

   b. Conflict monitor material certifications and mill tests, design calculations, and manufacturer’s installation recommendations.

   c. Switch pack material certifications and mill tests, design calculations, working drawings, and manufacturer’s installation recommendations.

   d. Flasher pack material certifications, and manufacturer’s installation recommendations.

   e. Two (2) channel isolator material certifications and mill tests, design calculations, working drawings, and manufacturer’s installation recommendations.
f. Modem material certifications, and manufacturer’s installation recommendations.

g. Type 2070 controller material certifications, and manufacturer’s installation recommendations.

h. Traffic controller cabinet material certifications, and manufacturer’s installation recommendations.

i. Fiber optic distribution (FDU) material certifications, and manufacturer’s installation recommendations.

j. Layer II switch material certifications, and manufacturer’s installation recommendations.

5. **Electrical Cable and Duct Installation**

   a. Conduit and conduit fittings material certifications and manufacturer’s installation recommendations.

   b. Grounding wires material certifications and manufacturer’s installation recommendations.

   c. Traffic signal cables material certifications and manufacturer’s installation recommendations.

   d. Push button lead-in cables material certifications and manufacturer’s installation recommendations.

   e. Service cables material certifications and manufacturer’s installation recommendations.

   f. Communication cables material certifications and manufacturer’s installation recommendations.

   g. Luminaire cables material certifications and manufacturer’s installation recommendations.

   h. Pull boxes material certifications and mill tests, design calculations, working drawings, and manufacturer’s installation recommendations.

6. **Pavement Markings**

   a. Pavement marking paint material certifications, notarized chemical analysis, and manufacturer’s installation recommendations.

   b. Glass beads material certifications and manufacturer’s installation recommendations.

   c. Preformed pavement marking tape material certifications and manufacturer’s installation recommendations.

   d. Preformed pavement marking tape primer material certifications and manufacturer’s installation recommendations.

7. **Traffic Control Devices**

   a. Luminaire housing material certifications, working drawings, and manufacturer’s installation recommendations.

   b. Luminaire material certifications, working drawings, and manufacturer’s installation recommendations.
c. Photoelectric control material certifications, working drawings, and manufacturer’s installation recommendations.

d. Signs material certifications and manufacturer’s installation recommendations.

e. Barricades material certifications and manufacturer’s installation recommendations.

f. Advance warning systems material certifications, working drawings, and manufacturer’s installation recommendations.

g. Wood posts material certifications and manufacturer’s installation recommendations.

h. Steel U-posts material certifications and manufacturer’s installation recommendations.

i. Mounting hardware material certifications and manufacturer’s installation recommendations.

j. Metal poles material certifications and mill tests, design calculations, working drawings, and manufacturer’s installation recommendations.

k. Mast arms material certifications and mill tests, design calculations, working drawings, and manufacturer’s installation recommendations.

l. Anchor bolts material certifications, design calculations, working drawings, and manufacturer’s installation recommendations.

m. Wire and cable material certifications and manufacturer’s installation recommendations.

n. Conduit material certifications and manufacturer’s installation recommendations.

o. Flagger certification documentation for flagger(s) furnished for the project.

8. Service Disconnects

a. Service enclosure material certifications, working drawings, and manufacturer’s installation recommendations.

b. Service disconnect enclosure material certifications and mill tests, design calculations, working drawings, and manufacturer’s installation recommendations.

c. Service conductors material certifications and manufacturer’s installation recommendations.

d. Wiring schematic created by drafting software.

e. Wood poles material certifications and manufacturer’s installation recommendations.

9. Vehicle Detectors

a. Vehicle detector amplifier material certifications and manufacturer’s installation recommendations.

b. Magnetic vehicle detector material certifications and manufacturer’s installation recommendations.

c. Magnetic vehicle detector amplifier material certifications and manufacturer’s installation recommendations.
d. Radar and/or microwave detectors material certifications and manufacturer’s installation recommendations.

e. Loop detector wire material certifications and manufacturer’s installation recommendations.

f. Detector lead-in cable material certifications and manufacturer’s installation recommendations.

g. Loop detector sealant material certifications and manufacturer’s installation recommendations.

10. Radar Vehicle Detection System

a. Radar vehicle detection system material certifications, working drawings, and manufacturer’s installation recommendations. References of detection system users having a minimum of six (6) months of operation, including agency name, address, telephone number, and contact person.

11. Preemption Control System

a. Preemption control system material certifications, working drawings, and manufacturer’s installation recommendations.

b. Detector cable material certifications and manufacturer’s installation recommendations.

900.02 Material Requirements

A. General

If the Contractor proposes to use materials different than what is specified in the Contract Documents, the Contractor shall submit proposed product information to the Engineer for approval. The submittal shall include, but not be limited to, the manufacturer’s serial and model numbers, material certifications, and installation recommendations. Do not construe Engineer’s acceptance of a submittal as relieving the Contractor of the responsibility to comply with the Contract Documents.

B. Sealing Compound

Aluminum-filled, resilient sealing compound shall be Minnesota Mining and Manufacturing Company (3M) Sealant Number 1751 or approved equal.

C. Aggregate for Base

Aggregate for base shall be in accordance with ASTM D2940, Standard Specification for Graded Aggregate Material for Bases or Subbases for Highways or Airports. Gradation requirements shall be one (1) inch clean limestone aggregate. Recycled concrete shall not be allowed.

D. Copper Grounding Wire, Grounding Rods, and Test Stakes

Copper grounding wire shall be No. 6 AWG stranded copper wire in accordance with ASTM B3, Standard Specification for Soft or Annealed Copper Wire. Copper grounding wire installed in conduit shall be No. 6 AWG green insulated stranded copper wire in accordance with ASTM B3, Standard Specification for Soft or Annealed Copper Wire. Grounding rods and test stakes shall comply with International Municipal Signal Association (IMSA) Specification Number 61 excluding length and diameter requirements. Ground rods and test stakes shall have a minimum diameter of five-eighth (5/8) inch. Supply ground rods and test stakes with a ground rod clamp.
E. Bonding Clamps

Bonding clamps shall be galvanized metal clamps that expand by tightening a set screw. Galvanizing shall be in accordance with ASTM A123, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

F. Conduit and Conduit Fittings

Conduit and conduit fittings for direct bury applications shall be galvanized rigid steel in accordance with UL-6, UL Standard for Safety for Electrical Rigid Metal Conduit – Steel; high-density polyethylene in accordance with ASTM F2160, Standard Specification for Solid Wall High Density Polyethylene (HDPE) Conduit Based on Controlled Outside Diameter (OD); or rigid polyvinyl chloride (PVC) in accordance with UL-651, UL Standard for Safety for Schedule 40 and 80 Rigid PVC Conduit. Conduit and conduit fittings for boring applications shall be high density polyethylene in accordance with ASTM D3035, Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter. Furnish in standard lengths with UL label. Rigid steel conduit fittings shall be galvanized steel or galvanized malleable iron. Galvanizing shall be in accordance with ASTM A123, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products. PVC conduit fittings and cement shall be compatible with the PVC conduit. Transitions between HDPE and PVC conduits shall conform to the manufacturer’s recommendations. Conduit size shall be the minimum trade size permitted for the application and shall have a constant circular cross sectional area. Conduit installed for above ground risers shall be galvanized rigid steel conduit.

G. Traffic Signal Cable

Traffic signal cable shall be No. 14 AWG solid wire traffic signal cable with the number of conductors indicated in the Contract Documents. Traffic signal cable shall be in accordance with IMSA Specification 20-1, Specification 20-2, and Specification 20-3. Color code conductors using coloring that penetrates the full thickness of the conductor insulation. Do not color-code using only printed words or numerals on the exterior of the conductor insulation.

H. Push Button Lead-in Cable

Push button lead-in cable shall be No. 16 AWG solid wire traffic signal cable with the number of conductors indicated in the Contract Documents. Push Button Lead-in cable shall be in accordance with IMSA Specification 20-1, Specification 20-2, and Specification 20-3. Color code conductors using coloring that penetrates the full thickness of the conductor insulation. Do not color-code using only printed words or numerals on the exterior of the conductor insulation.

I. Service Cable: Types Service Conductors (SC), Service-Entrance Conductors (SEC), and 3-Conductors (3/C)

Service cable for the power source circuits shall be Type THWN copper conductor, gasoline and oil resistant, 600 Volt AWG. Service cable wire shall be black in color and the neutral wire #6 AWG or smaller shall be white. Cables installed for streetlight luminaries, referred to as 3-conductors (3/C), shall be #6 AWG wire.

J. Communication Cable

Copper twisted pair communication cable shall be No. 22 AWG solid wire and shall be in accordance with REA Specification PE-39 and IMSA Specification 60-6. The cable shall contain the number of pairs specified in the Contract Documents.

Fiber optic communication cable shall be loose tube, gel-free, standard single mode dielectric cable. The cable shall be listed in the latest edition of the Rural Utilities Service (RUS) List of
Materials Acceptable for Use on Telecommunications Systems of RUS Borrowers, Category oc, and shall have a short-term tensile rating of at least 600 pounds. The cable shall be in accordance with the Contract Documents.

Video cable shall meet the requirements of the system manufacturer.

900.03 Construction Requirements

A. General

Before ordering materials, locate overhead or underground utilities to verify that they do not interfere with the work indicated in the Contract Documents. Order all poles, mast arms, span wires, anchors, and related materials necessary to complete the work in accordance with the Contract Documents, but no later than ten (10) calendar days after receiving approval of the submitted materials information. Submit proof of the orders and estimated delivery time to the Engineer in accordance with the Contract Documents, but no later than fifteen (15) calendar days after receiving approval of the submitted materials information. Identify any materials already in possession.

Obtain all licenses and permits before commencing the work. Agency identification signs shall be constructed and erected in accordance with the Manual of Barricading Standards, Specifications, Methods, and Materials for the City of Omaha. This work shall be considered incidental to other items for which the Contract provides direct payment.

A licensed journeyman electrician or lineman shall directly supervise any work involving the installation of cable, foundations, structural steel, and traffic control equipment. Wire all circuits as required by the Contract Documents, clear of faults, grounds, and open circuits. Connect the service neutral conductor and all interconnected equipment grounding conductors solidly to a driven ground rod at the traffic signal service disconnect pedestal. Installations shall be in accordance with all applicable sections of the National Electrical Code (NEC), National Electrical Safety Code (NESC), Manual on Uniform Traffic Control Devices (MUTCD), American Welding Society (AWS) specifications, all governing local ordinances and regulations, and the Contract Documents.

Schedule work to minimize the time any signal is inoperable. During this time, provide, place, and maintain temporary traffic control devices in accordance with the Manual of Barricading Standards, Specifications, Methods, and Materials for the City of Omaha. Maintain a minimum of two (2) lanes of traffic on one-way streets and one (1) lane of traffic in each direction on two-way streets open to traffic during the work. Open all lanes to traffic during peak hours as directed by the Engineer or Contract Documents. Maintain traffic through open intersections at all times.

Coordinate work with all other phases of the project to minimize conflict between combined operations. Schedule work and material deliveries to meet the project schedule. Arrange for all necessary electrical services at locations indicated in the Contract Documents. The utility company or Engineer may alter the service location in the field to adapt to field conditions.

Trim trees or shrubs in accordance with Section 100 as necessary to install the poles, mast arms, or span wires.

Do not disconnect or damage an operational communication cable while performing work around traffic signal systems unless otherwise indicated in the Contract Documents. Reconnect, repair, or establish a temporary connection within eight (8) hours of disconnecting or damaging a communication cable.
Any surface materials disturbed by trenching, excavating, or backfilling operations shall be replaced in accordance with the Contract Documents or as directed by the Engineer. Dispose of all excess materials in accordance with Section 100.

Notify the Engineer a minimum of forty-eight (48) hours before placing the system into operation. Do not put the system into operation without the Engineer present. Test the circuits installed before activating the system. Secure the services of a person qualified to operate and adjust the system. Activate and operate the system in normal fashion as soon as possible if the road is open to public travel at the time the installation or any workable segment of the installation is completed.

Before final acceptance, demonstrate by tests to the Engineer’s satisfaction that all electrical installations are in proper condition as required by the Contract Documents. Do not construe operation of the system as acceptance of the system, acceptance of any part of the system, or as a waiver of any Contract provisions. All electrical installations are subject to a thirty (30) day trial period before the Engineer may consider the installation for acceptance. The City shall pay for electrical energy consumed by the system during the thirty (30) day operational trial period.

After the system is turned on and operational, the City shall assume responsibility for routine maintenance. Maintenance activities by the City do not relieve the Contractor of any responsibility for failures due to workmanship or materials that occur before final acceptance of the project. The Engineer shall determine the responsibility of the Contractor relating to any failure occurring before final acceptance.

Transfer any guarantees or warranties on materials purchased to the City upon acceptance of the work. Purchase materials with transferable guarantees or warranties.

B. Conduits and Cables

Size conduits and bends in accordance with the Contract Documents, or to be equivalent to the connecting conduit in the ground. Route conduits to avoid conflicts with the reinforcing steel or anchor bolts in the foundation. Install conduit a minimum of thirty (30) inches below the ground surface. For conduit connections to existing foundations, remove a sufficient amount of concrete to place the conduit inside the anchor bolts of the foundation. Position the conduit and place concrete or grout. Finish the concrete or grout to match the existing foundation.

Route cables to their destinations in cabinets, pole bases, pull boxes, and all other terminations. Follow all manufacturer-recommended values for the allowable bending radii for permanent routing during installation. Connect cables at the control cabinet using terminal boards provided for this purpose. Equip each stranded wire inserted under a binder screw with a solder-less, pressure-type spade connector with a pre-insulated shank. Do not use more than one (1) stranded wire with each spade connector. Do not insert more than three (3) spade connectors under a single binder screw unless otherwise indicated in the Contract Documents. Do not use a spade connector when terminating solid conductor wires. Insert only one (1) solid conductor wire under a binder screw.

Drill cable inlet holes in the field as necessary. Drip loops shall be installed when cables come out of poles and into mast arms, and when cables come out of mast arms and into signal heads.

C. Materials Handling

Use handling techniques that avoid damaging the galvanized surface. The Engineer reserves the right to reject any damaged materials. Remove all irregularities from cast parts. Tubing shall be seamless, and exterior and interior surfaces shall be clean, smooth, and free from slivers,
lamination, grooves, cracks, or other defects. The Engineer reserves the right to reject any work containing poor welding workmanship, as noted by visual or other inspection.

The Contractor is responsible for any repairs and/or replacement of materials that result from damage due to improper storage and protection before installation.
901 Foundations, Poles, Mast Arms, and Luminaires

901.01 General

A. Description
This work includes furnishing and installing support cable poles, mast arm poles, combination mast arm and lighting poles, street light poles, and pedestal poles, luminaires, and all other miscellaneous items as indicated in the Contract Documents.

B. Submittal Requirements
Refer to Section 900.01 B for submittal requirements.

901.02 Material Requirements

A. General
Refer to Section 900.02 for general material requirements, in addition to the following requirements.

B. Design Criteria
The maximum design wind velocity and gust factor for the design of all metal span wire poles, mast arm poles, combination mast arm and lighting poles, cantilever sign structures, streetlight poles, pedestal poles, breakaway bases, and signal mast arms shall be in accordance with the 2013 AASHTO Specifications for the Design and Construction of Structural Supports for Highway Signs, Luminaires and Traffic Signals, 6th Edition. Design standards for wind loading, fatigue analysis, galloping, truck induced gust loading, and natural wind gusts are below. The specifications for these poles shall be in accordance with the Standard Plates and Contract Documents.

- Wind Speed: Ninety (90) mph wind speed. (AASHTO Section 3.8.2, Figure 3.8.3)
- Wind Recurrence Intervals: Fifty (50) year recurrence interval. (AASHTO Section 3.8.3)
- Unreinforced & Reinforced Holes and Cutouts: Design structure unreinforced and reinforced holes to conform to section 5.14.6. (AASHTO Section 5.14.6)
- Fatigue Category: Fatigue Category 2. (AASHTO Section 11.6)
- Galloping Loads: Structure shall not be designed to resist galloping-induced cyclic loads. An effective vibration mitigation device shall be used to resist galloping-induced cyclic loads. (AASHTO Section 11.7.1.1)
- Natural Wind Gust: Structure shall be designed to resist a natural wind gust load of eleven and two-tenths (11.2) mph, based on the yearly mean wind velocity. (AASHTO Section 11.7.1.2)
- Truck Loads: Structure shall not be designed to resist truck-induced gust loads. (AASHTO Section 11.7.1.3)

An effective vibration mitigation device shall be installed on new mast arm poles forty-five (45) feet or longer designed to the 2013 AASHTO standard. The vibration mitigation device shall be pre-approved by the City of Omaha and in accordance with in the Contract Documents. The vibration mitigation device will be a separate bid item to the cost of the Combination Mast Arm Pole, Street Light Pole or the cost of the Mast Arm Pole.

Design structures to support the required signal heads, lighting systems, signal and lighting cables, signage, and other required items for the location and span indicated in the Contract
Documents. Use the area of the signs shown or as noted on the Contract Documents for design calculations. For support cable installations, design metal poles to support the required signal heads, signal and lighting cables, and signage for the span length required with a worst angle of seventy (70) degrees. For all other installations, design metal poles to support the required signal heads, signal and lighting cables, other equipment and signage. Design all metal poles to support a twenty (20) foot luminaire extension with a fifteen (15) foot luminaire arm and seventy-five (75) pound luminaire. Once selected, use the same design patterns, materials, and basic member shape throughout the project unless otherwise indicated in the Contract Documents.

Design the pedestal pole and breakaway base to support the pole, signal load, signal and lighting cables, other equipment, and signage. The maximum design wind velocity shall be ninety (90) miles per hour after installation. The manufacturer shall design and test the breakaway base in accordance with all applicable AASHTO requirements.

Design signal mast arms to support the required signal or luminaire load and the required signal and lighting cables. The maximum design wind velocity shall be ninety (90) miles per hour after installation.

Poles designated as Mast Arm Signal Poles (Type “MP”) shall conform to the “Pole Extension for 19'-0” Poles” detail of Standard Plate 901-02. Poles designated as Combination Mast Arm Signal and Lighting Poles (Type “CMP”) shall have a pole construction consisting of a single vertical piece. CMP poles with two-piece construction (utilizing a pole extension) shall not be used.

C. Metal Poles

Metal poles shall consist of a round, tapered pole shaft of galvanized steel fabricated in accordance with the Contract Documents. Metal poles shall have one (1) longitudinal automatic electric weld. After forming, flatten the weld. Steel shall be in accordance with ASTM A595, Standard Specification for Steel Tubes, Low Carbon, Tapered for Structural Use. Incorporate a lifting U-hook at the top of the shaft. The U-hook shall be capable of supporting the weight of the entire pole.

The pole manufacturer shall state the amount of pole rake necessary for the pole to set plumb under the required loading after installation. The manufacturer shall certify that the metal pole(s) and hardware meet the strength requirements for the anticipated loading.

Secure a one (1) piece galvanized steel anchor base of adequate strength, shape, and size to the lower end of the shaft using two (2) continuous electric arc welds. The base shall telescope the shaft of the pole. Locate one (1) weld inside the base at the end of the shaft. Locate one (1) weld outside the base at the joint between the base top and the pole shaft.

Furnish all hardware necessary to complete the metal pole assembly in accordance with the pole manufacturer’s instructions. Hardware shall include, but not be limited to, bolts, nuts, washers, removable pole tops, anchor bolts, anchor bolt covers, and transformer bases. Galvanize all exposed metal hardware. Removable pole tops shall consist of a galvanized positioning cap screw and galvanized pole cap. Furnish one (1) rubber grommet of one (1) inch inside diameter for each signal arm mounting location. Furnish transformer bases for all installations at signalized intersections. Furnish transformer bases for all installations between signalized intersections as indicated in the Contract Documents.

Galvanizing shall be in accordance with ASTM A123, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
D. Bronze Colored Poles

Any mast arm signal poles, combination mast arm signal and street light poles, and street light poles shown in the Contract Documents as “Bronze Colored” shall be treated with either a Powder Coat or a Liquid Coat Paint Process as follows:

1. Powder Coat Process

Prior to being incorporated into an assembled product, steel plates three-fourth (¾) inches or more in thickness shall be blast cleaned to remove rolled-in mill scale, impurities, and non-metallic foreign materials. After assembly, all weld flux shall be mechanically removed.

The iron or steel product shall be degreased by immersion in an agitated four and one-half (4.5) to six (6) percent concentrated caustic solution elevated to a temperature ranging from one-hundred fifty (150) to one-hundred eighty (180) degrees Fahrenheit and pickled by immersion in a heated sulfuric acid solution of six (6) to thirteen (13) percent concentration at a controlling temperature of one-hundred fifty (150) degrees Fahrenheit. It shall be rinsed clean from any residual effects of the caustic or acid solutions by immersion in a circulating fresh water bath.

Finally, the iron or steel product shall be immersed in a concentrated zinc ammonium chloride flux solution heated to one-hundred thirty (130) degrees Fahrenheit. The solution’s acidity content is to be maintained between four and one-half (4.5) and five (5.0) pH. The assembly is to be air dried to remove any moisture remaining in the flux coat and/or trapped within the product.

The product shall be hot-dip galvanized before it is painted, in accordance with ASTM A123, Standard Specification for Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products, by immersion in a molten bath of prime western grade zinc maintained between eight-hundred ten (810) to eight-hundred fifty (850) degrees Fahrenheit. Maximum aluminum content of the bath is controlled to one-hundredth (0.01) percent. Flux ash is skimmed from the bath surface prior to immersion and extraction of the product to assure a debris free zinc coating.

The paint shall be of a powder oven-applied (baked) type, either Triglycidyl Isocyanurate (TGIC) or Urethane Polyester Powder, that will not chip off or fade under the severe local weather conditions, to a minimum dry film thickness (DFT) of two (2.0) mils. Prior to application, the surfaces to be powder coated are mechanically etched by brush blasting in accordance with Steel Structures Painting Council SP-7, Brush-Off Blast Cleaning, and the zinc coated substrate preheated to four-hundred fifty (450) degrees Fahrenheit for a minimum of one (1) hour in a gas-fired convection oven. The coating is to be electrostatically applied and cured by elevating the zinc-coated substrate temperature to a minimum of four-hundred (400) degrees Fahrenheit in a gas-fired convection oven.

The color of the paint shall be dark bronze in accordance with Powder Technologies number PTTS49-OS36; Valmont Structures standard Dark Bronze; or dark brown in accordance with National number 20040.

2. Liquid Coat Process

When required, all metal surfaces are cleaned by blasting with steel shot to remove all oil, grease, dirt, mill scale, rust, corrosion, oxides, paint, or other foreign matter. The surface
finish shall be in accordance with Steel Structures Painting Council SP-6, Commercial Blast Cleaning.

After fabrication the finished product shall be hot-dip galvanized in accordance with ASTM A123, Standard Specification for Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products.

Prior to paint application, the galvanized product shall be sweep blasted in accordance with Steel Structures Paint Council SP-7, Brush-Off Blast Cleaning, which includes the degree of cleanliness and an average angular anchor profile of one and one-half (1.5) to two and one-half (2.5).

By-products from the sweep blasting process shall be removed with dry, compressed air. Prime coating may proceed immediately after blasting. The prime coat shall be applied within eight (8) hours of the sweep blasting.

The prime coat on the exterior of the pole shall be Baril ZRU one (1) component moisture cure zinc rich polyurethane coating. The zinc rich prime coat shall be electrostatically applied to the sweep-blasted and blown-dry finish. A nominal coating thickness of three (3) mils (dry film measurement) shall be applied in a single application.

Drying temperature and drying time shall be in accordance with the paint manufacturer recommendations.

The finish coat system shall be Baril I2 two (2) component High Solids Aliphatic Polyurea liquid coat system electrostatically applied to the polyurethane prime coat finish. A nominal coating thickness of two and one-half (2.5) mils (dry film measurement) shall be applied in a single application. Finish color shall be in accordance with Millerbernd number 17-FTU-111.

The ZRU/I2 combination of prime coat and finish coat application shall be designed to exceed a five-thousand (5,000) hour salt spray.

The coating manufacturer shall be FREDA Incorporated, 401 Growth Parkway, Angola, IN 46703, PH: 800-348-4621.

The following terms and their definitions shall apply to the Liquid Coat Process:

- **Flash** – The process of allowing the paint coat surface to air dry sufficiently enough to apply the next coat of paint, without blending of the two coats upon application of the second coat.

- **Cure** – The process of chemical change in the paint coating to develop its full hard potential. Applied paint coatings are cured utilizing oxidation in the Air Dry process.

  NOTE: All paint coatings, regardless of its cure design, require a seven (7) day cure time at a minimum of seventy-seven (77) degrees Fahrenheit before it will develop its full cure potential.

- **Air Dry Process** – Paint coatings designed to obtain full hard and dry potential utilizing normal ambient temperature and time.

- **Electrostatically Applied** – The spray application of paint where the particles are charged causing them to be attracted to the grounded surface.

- **High Solids, Medium Solids, Conventional Paint** – These terms reflect the category of paint in its ready-to-apply state, relating the ratio of paint pigment and
color to its solvent carrier. The liquid coat process shall utilize the maximum amount of paint solids formulated to reduce Volatile Organic Compounds (VOCs) and Hazardous Air Pollutants (HAPs) while still complying with the application process and paint finish requirements.

Range:  
- 0% to 35% solids: Conventional Paint Coatings.  
- 35% to 45% solids: Medium Solids Paint Coatings.  
- 45% to 100% solids: High Solid Paint Coatings.

E. **Wood Poles**

Wood poles shall be southern pine, douglas fir, western red cedar, or northern white cedar in accordance with ASTM D25, Standard Specification for Round Timber Piles; and ANSI 05.1, Wood Poles, Specifications and Dimensions. Treat poles using the Rueping Process with a minimum of ten (10) pounds of five (5) percent pentachlorophenol solution per cubic foot of timber in accordance with AASHTO M133, Preservatives and Pressure Treatment Process for Timber. Roof, gain, and bore poles before full-length preservation treatment. Locate markings ten (10) feet above the butt of the pole. Cut gains on the concave side or side having the greatest curvature in poles having a reverse or double sweep. Gained surfaces shall be in parallel planes.

Poles in line shall not have sweeps or short crooks exceeding fifty (50) percent of the maximum allowed. Less than twenty (20) percent of the poles shall contain the maximum allowable sweeps and short crooks.

Store poles by stacking them on creosote-treated or decay-resisting skids a minimum of one (1) foot above the ground. Arrange skids to avoid distortion of the poles. Stack poles to permit free circulation of air. Remove any decaying wood from beneath stored poles.

F. **Pedestal Poles**

Pedestal poles shall consist of a spun, seamless aluminum-alloy 6063-T6 shaft in accordance with ASTM B429, Standard Specification for Aluminum-alloy Extruded Structural Pipe and Tube. The minimum wall thickness of the pole shall be one-fourth (¼) inch. The minimum inside diameter shall be four (4) inches. The minimum outside diameter shall be four and one-half (4½) inches. The manufacturer shall certify that the pedestal pole(s) and base(s) meet the strength requirements for the anticipated loading.

Support the pedestal pole using a breakaway base comprised of cast aluminum in accordance with ASTM B179, Standard Specification for Aluminum-alloys in Ingot and Molten Forms for Castings. The breakaway base shall have an approximate height of fifteen (15) inches with a maximum diameter of seventeen (17) inches.

Furnish all hardware necessary to complete the pedestal pole assembly. Galvanize all exposed metal hardware. Galvanizing shall be in accordance with ASTM A123, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products. Furnish one (1) rubber grommet of one (1) inch inside diameter for each signal or luminaire mounting location.

G. **Anchor Bolts**

Anchor bolts shall be in accordance with either ASTM A307, Standard Specification for Carbon Steel Externally and Internally Threaded Standard Fasteners or ASTM F1554, Standard Specification for Anchor Bolts, Steel, Grade 55, and the Contract Documents. The manufacturer shall certify that the anchor bolts meet the strength requirements for the anticipated loading of the pole(s). The minimum yield strength shall be sixty thousand (60,000) psi. Thread the bolts a sufficient length to allow for proper installation. Threads shall be full and sound. Galvanize all
exposed portions of the anchor bolt. Supply two (2) galvanized hexagon nuts and two (2) galvanized flat washers with each anchor bolt. Galvanizing shall be in accordance with ASTM A123, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products or ASTM F2329, Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws Washers, Nuts, and Special Threaded Fasteners.

H. Mast Arm Pole Transformer Bases

Mast arm pole transformer bases shall be in accordance with Standard Plate 901-04 and the Contract Documents. Mast arm pole transformer bases shall be galvanized steel in accordance with ASTM A27, Standard Specification for Steel Castings, Carbon, for General Application. The mast arm pole transformer base shall be designed to meet the appropriate size, shape, and loading for the pole anchor base and pole foundation. The manufacturer shall certify that the mast arm pole(s) and transformer base(s) meet the strength requirements for the anticipated loading.

I. Signal Mast Arms

Signal mast arms shall be in accordance with Standard Plate 901-02 and the Contract Documents. Steel shall be in accordance with ASTM A595, Standard Specification for Steel Tubes, Low Carbon, Tapered for Structural Use. Galvanizing shall be in accordance with ASTM A123, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products. Signal mast arms shall consist of a galvanized steel shaft with a mounting device pre-approved by the City of Omaha suitable for attaching the arm at the height specified in the Contract Documents. Signal mast arms less than fifty-five (55) feet shall be one (1) piece arms. Signal mast arms fifty-five (55) feet or longer may be one (1) or two (2) piece arms. The mounting shall be structurally sound and neat in appearance. The signal mast arm shall be field adjustable or provide a minimum of two (2) and a maximum of four (4) degree rise. Supply a mast arm cap for the free end of the mast arm. Furnish one (1) rubber grommet of one (1) inch inside diameter for each signal mounting location. The manufacturer shall certify that the signal mast arm(s) meet the strength requirements for the anticipated loading.

J. Luminaire Arms and Extensions

Luminaire arms and extensions shall be in accordance with Standard Plate 901-09 and the Contract Documents. Luminaire arms and extensions shall consist of a galvanized steel shaft with a mounting device suitable for attaching the arm and/or extension at the height specified. Steel shall meet the requirements for two (2) inch Grade A or Schedule 40 pipe in accordance with ASTM A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless. The mounting shall be structurally sound and neat in appearance. The mating arm and pole steel simplex attachments shall meet the requirements for Grade 65-35 steel castings in accordance with ASTM A27, Standard Specification for Steel Castings, Carbon, for General Applications. Channel scrolls shall be one and one-half (1½) inch by one and one-half (1½) inch by one-eighth (⅛) inch commercial grade steel. The manufacturer shall certify the luminaire arm(s) and extension(s) meet the strength requirements for the anticipated loading.

K. Luminaires

Unless otherwise indicated in the Contract Documents, Omaha Public Power District (OPPD) shall supply the luminaire(s).
L. Grout
Grout shall be non-shrinking and non-rusting and comply with the requirements for Grade A Pre-Hardening Volume-Adjusting Grout in accordance with ASTM C1107, Standard Specification for Packaged Dry, Hydraulic-Cement Grout.

M. Anchors and Anchor Rods
Anchors shall be three-way (3-way) expanding malleable iron anchors having a minimum diameter of eight (8) inches. Malleable iron shall be in accordance with ASTM A47, Standard Specification for Ferritic Malleable Iron Castings. Anchor rods shall be eight (8) feet long, five-eighth (\(\frac{5}{8}\)) inch diameter galvanized steel rods with a thimbleye end. Galvanizing shall be in accordance with ASTM A123, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

N. Guy Wire and Guy Guards
Guy wire shall be three-eighth (\(\frac{3}{8}\)) inch diameter, seven (7) wire, high-strength grade cable with Class A zinc coating in accordance with ASTM A475, Standard Specification for Zinc-Coated Steel Wire Strand. Guy guards shall be eight (8) feet long, half-round, galvanized metal guards. Galvanizing shall be in accordance with ASTM A123, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

O. Support Cable
Support cable shall be three-eighth (\(\frac{3}{8}\)) inch diameter, seven (7) wire, high-strength grade cable with Class A zinc coating in accordance with ASTM A475, Standard Specification for Zinc-Coated Steel Wire Strand.

P. Traffic Signal Tether Cable
Traffic signal tether cable shall be one-fourth (¼) inch diameter, seven (7) wire cable with Class A zinc coating in accordance with ASTM A475, Standard Specification for Zinc-Coated Steel Wire Strand.

901.03 Construction Requirements
A. General
Refer to Section 900.03 for general construction requirements, in addition to the following requirements.

B. Foundation Construction
Construct reinforced PCC foundations in accordance with Section 600 and the sizes and dimensions indicated in the Contract Documents and Standard Plates. Excavate, dig, and/or bore holes at the locations indicated in the Contract Documents or as directed by the Engineer. The excavation shall be dry and free of any loose materials before placing PCC. Forms shall be used for any portion of the foundation that will be exposed above ground. Level and secure all forms before commencing PCC placement. Install and secure all reinforcing steel, conduit, and anchor bolts before commencing PCC placement.

Concrete shall be Type L65 in accordance with Table 500.03. Consolidate the PCC throughout the full depth of the foundation by inserting and withdrawing a vibrator multiple times during PCC placement.
Finish the top of the foundation to be approximately two (2) inches above the adjacent ground or structure unless otherwise indicated in the Contract Documents. Finish the top of the foundation to be flush with adjacent sidewalk.

Form removal and surface finishing shall be in accordance with Section 600. Grout shall be installed in accordance with the Standard Plates.

Backfill the excavation and restore any areas disturbed by the foundation construction. Backfill shall be in accordance with Section 200.

1. **Pole Foundations**
   
   Metal pole foundations shall be round. Pedestal pole foundations shall be round or square. The minimum dimension for the mounting surface shall be two and one-half (2½) inches greater than the pole base or transformer base on all sides. Pole foundations shall be constructed in accordance with the Standard Plates.

   Install and secure anchor bolts within the reinforcing steel before commencing PCC placement. Center the bolt circle in the middle of the foundation and set the anchor bolts plumb at a projection distance above the finished surface in accordance with the manufacturer’s recommendations. Conduit bends shall be ninety (90) degrees and shall exit the foundation a minimum of thirty (30) inches below the surrounding surface. Plug the ends of the conduit before commencing PCC placement.

2. **Transformer Pad Foundations**
   
   Construct transformer pad foundations in accordance with Standard Plate 903-01. Uniformly place and compact an aggregate base without causing segregation or displacing or damaging the underlying subgrade or conduit. Do not place aggregate material if the subgrade is frozen. Shape the aggregate material to produce a uniform surface. The Contractor shall perform compaction efforts using mechanical methods.

C. **Ground Rod Installation**

Supply and install a ground rod in accordance with the Standard Plates, the Contract Documents, and NEC Article 250. Install a No. 6 AWG stranded copper wire attached to the ground rod using an appropriate clamp and connected to the splice box on the pole shaft. Use No. 6 AWG green insulated stranded copper wire for conduit installations. Grounding shall be in accordance with the NEC, local ordinances, all applicable codes, and the requirements of the local utility company supplying electrical power. Do not connect any grounding connections to a breakaway device. The maximum measurable resistance between the ground rod and a test stake driven two (2) feet into the ground adjacent to the pole foundation shall not exceed twenty-five (25) ohms. If the resistance exceeds twenty-five (25) ohms, install additional ground rods greater than six (6) feet apart and connected using a No. 4 AWG bare copper wire. The number of additional ground rods shall be as needed to produce a measurable resistance of less than twenty-five (25) ohms.

D. **Metal Pole Installation**

Install metal poles at locations indicated in the Contract Documents and in accordance with the Standard Plates. Prepare the top of the PCC foundation to provide for proper seating of the pole base. Heavily coat all areas that contact the PCC foundation on all aluminum bases with an aluminum-filled, resilient sealing compound. Install the poles in accordance with the manufacturer's recommendations and the Contract Documents. Position the pole with the hand hole facing away from vehicular traffic wherever possible. Install leveling nuts as directed by
the pole manufacturer regardless of the need for adjustment. Install a one (1) inch inside diameter rubber grommet below the mast arm installation location. Plumb poles using shims supplied by the pole base manufacturer. After plumbing the metal pole, fill any void between the pole base and the pole foundation with grout. Install a one-half (½) inch conduit in the grout for drainage as directed by the Engineer.

E. Mast Arm Signal Pole Installation

Install mast arm signal poles and mast arms at locations indicated in the Contract Documents and in accordance with the Standard Plates. The Contractor shall provide the required anchor bolts and hold down lugs as part of the cost to either install a mast arm pole provided by the City or to reinstall a mast arm pole, unless otherwise indicated in the Contract Documents. The Contractor shall check the anchor bolt size and bolt circle of the City-provided mast arm pole before ordering the anchor bolts and constructing the foundation base. Hold down lugs shall be provided for both the top and bottom sides of the bottom plate of the transformer base. If the constructed foundation and anchor bolts do not fit the mast arm pole, then the Contractor shall construct a new foundation with the correct anchor bolt size and bolt circle at no additional cost to the City.

Install mast arms in accordance with the manufacturer’s recommendations and such that the loaded arm has a minimum clearance of seventeen (17) feet from bottom of all signals to the crown of the roadway. Rake the pole back more than the calculated deflection, load the pole, and plumb the pole by adjusting the leveling nuts.

F. Wood Pole Installation

Install wood poles at locations indicated in the Contract Documents and in accordance with Standard Plate 901-06.

Do not drag treated poles along the ground. Do not handle poles using pole tongs, cant hooks, or other tools that produce indentations greater than one (1) inch. Do not apply tools to the section of the pole located one (1) foot above and two (2) feet below the ground surface.

Verify that the wood pole is plumb before backfilling commences. Backfill shall be in accordance with Section 200.

G. Support Cable and Tether Cable Installation

Install support cable and tether cable at locations indicated in the Contract Documents and in accordance with Standard Plate 901-06. Bond the support cable to the grounding system.

H. Luminaire Installation

Install luminaires at locations indicated in the Contract Documents and in accordance with the Standard Plates and manufacturer’s recommendations. Repair any scratches or mars in the paint in accordance with the manufacturer's recommendations. Provide and install conductors in the pole shaft and luminaire arm. Provide a minimum of thirty-six (36) inches of excess luminaire cable extending beyond the end of the luminaire mast arm. Connect the conductors in the pole shaft to the 3/C street lighting cable. Connect the 3/C street lighting cable to the proper circuit breaker at the service disconnect pedestal unless otherwise indicated in the Contract Documents or directed by the Engineer.

901.04 Acceptance

The Engineer shall observe the work to check for compliance with the Contract Documents. Concrete foundations shall be constructed to the minimum compressive strength requirements
identified in the Contract Documents. The Engineer shall verify the compressive strength of the concrete in accordance with the City of Omaha Materials and Testing Manual for Public Works Construction.

901.05 Measurement and Payment

The Engineer shall measure mast arm signal poles for payment by the type of each mast arm signal pole supplied, installed, and accepted.

The Engineer shall measure combination mast arm signal and lighting poles for payment by the type of each combination mast arm signal and lighting pole supplied, installed, and accepted.

The Engineer shall measure pedestal poles for payment by the type of each pedestal pole supplied, installed, and accepted.

The Engineer shall measure wood poles for payment by the size of each wood pole supplied, installed, and accepted.

The Engineer shall measure street light luminaires for payment by the type of each luminaire supplied, installed, and accepted.

The Engineer shall measure support cables for payment by the linear feet of support cable installed between poles and accepted. Sag shall not be included in the measurement of the support cable.

The Engineer shall measure tether cables for payment by the linear feet of tether cable installed between poles and accepted. Sag shall not be included in the measurement of the tether cable.

The following items are considered subsidiary to items for which the Contract provides direct payment: foundation and pole design, licenses, or associated permits; tree or shrub trimming; loading, hauling, and installing all materials, mounting hardware, ground rod(s), and miscellaneous hardware; installing wire and/or conduit into an existing base/foundation/pad; installing guy wires and guy anchor assemblies; and restoration of the surrounding ground surface. Mast arms and luminaire arms are subsidiary to mast arm signal poles and combination mast arm signal and lighting poles.

Payment shall be made under the following unless otherwise indicated in the Contract Documents. The Contract Price shall be full compensation for furnishing all labor, materials, equipment, tools, transportation, permits, licenses, and all incidentals necessary to complete the work.

When materials are furnished by the City, delivery of the specific items furnished shall be accepted at the location(s) identified in the Contract Documents. The Engineer shall measure each item furnished by the City for payment of each item installed and accepted.
<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Furnish and Install Mast Arms Signal Pole, Type MP-___</td>
<td>Each</td>
</tr>
<tr>
<td>Install Mast Arm Signal Pole, Type MP-___</td>
<td>Each</td>
</tr>
<tr>
<td>Furnish and Install Combination Mast Arm Signal &amp; Lighting Pole, Type CMP-__</td>
<td>Each</td>
</tr>
<tr>
<td>Install Combination Mast Arm Signal &amp; Lighting Pole, Type CMP-__ - ____</td>
<td>Each</td>
</tr>
<tr>
<td>Furnish and Install ___’ Wood Pole</td>
<td>Each</td>
</tr>
<tr>
<td>Furnish and Install ___’ Wood Pole with 12’ Luminaire Extension</td>
<td>Each</td>
</tr>
<tr>
<td>Furnish and Install Pedestal Pole, Type PP-__</td>
<td>Each</td>
</tr>
<tr>
<td>Install Pedestal Pole, Type PP-__</td>
<td>Each</td>
</tr>
<tr>
<td>Install ___W Street Light Luminaire</td>
<td>Each</td>
</tr>
<tr>
<td>Furnish and Install Support Cable</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Furnish and Install Tether Cable</td>
<td>Linear Foot</td>
</tr>
</tbody>
</table>
902 Traffic Signals

902.01 General
   A. Description
   This work includes furnishing and installing traffic signals and all other miscellaneous items
   necessary to provide an operable signal system as indicated in the Contract Documents or as
   directed by the Engineer.

   B. Submittal Requirements
   Refer to Section 900.01 B for submittal requirements.

902.02 Material Requirements
   A. General
   Refer to Section 900.02 for general material requirements, in addition to the following
   requirements.

   B. Conventional Traffic Signals
   Traffic signal heads shall be black polycarbonate sections in accordance with Vehicle Traffic
   Control Signal Heads, ITE publication numbers ST-052 & ST-054, Equipment and Material
   Standards of the ITE. The traffic signal head body, doors, visors, and back plates shall be black.
   Impregnate the coloring into the polycarbonate material such that scratches do not expose non-
   black material. All sections shall be interchangeable and fit to allow combining in a tier.

   Signal heads shall allow visors to attach using screws such that the installation or removal of the
   visor does not require modification of the signal head or special tools. Install visors around each
   traffic signal module. Use tunnel-type visors having a minimum circumference of seventy-five
   (75) percent of the traffic signal module lens circumference for all non-optically programmed
   sections. Use a cutaway-type visor for all optically programmed sections.

   Mount a terminal block on the back of the second section of the signal head. The terminal block
   shall be a four (4) position, eight (8) terminal barrier-type strip. Mount the terminal block in
   accordance with the manufacturer's recommendations.

   Doors shall be weather-tight. Hinges shall use enclosed, solid, non-corrosive, metallic hinge
   pins. Doors shall secure using wing nut clamps or similar securing mechanisms.

   Equip traffic signal heads with back plates as indicated in the Contract Documents. Back plates
   shall consist of a one (1) piece, vacuum-formed, ABS plastic plate having a minimum thickness
   of one-eighth ($\frac{1}{8}$) inch and a flange wall on all sides with a minimum thickness of five-eighth
   ($\frac{5}{8}$) inch. Install back plates in accordance with the manufacturer's recommendations.

   Light Emitting Diode (LED) traffic signal indicators shall be in accordance with Chapter 2, Vehicle
   Traffic Control Signal Heads, and Chapter 2a, VTCSH Part 2: Light Emitting Diode (LED) Vehicle
   Signal Modules, ITE publication numbers ST-052 & ST-054, Equipment and Material Standards
   of the ITE. LED traffic signal indicators shall be in accordance with Federal Communication
   Commission (FCC) requirements for noise generation.

   Unless otherwise indicated in the Contract Documents, all red, yellow, and green traffic signal
   indicators shall be LED signal indicators.

   Use the same model and manufacturer for each size of LED traffic signal indicators.
C. Optically Programmed Traffic Signals

Optically programmed traffic signals shall consist of a signal head, objective lens, optical limiter-diffuser, lamp, and lamp collar. The optical system shall accommodate projection of diverse, selected identifying marks to separate portions of the roadway such that only one (1) indication will be simultaneously apparent to any viewer. The projected indication shall be in accordance with the transmittance and chromaticity standards of Vehicle Traffic Control Signal Heads, ITE publication numbers ST-052 & ST-054, Equipment and Material Standards of the ITE.

Design optically programmed traffic signals to meet the following requirements:

1. Determine the visibility zone of the signal optically without louvers or shields.
2. Allow the selective veiling of the projected indication anywhere within fifteen (15) degrees of the optical axis.
3. Mount as a single section, a multiple section, or in combination with other signals.
4. Incorporate a standard one and one-half (1½) inch fitting.
5. Allow incremental tilting through an adjustable connection for a range of zero (0) to ten (10) degrees while maintaining a common horizontal and vertical axis through couples and mountings.
6. Allow external adjustment about the mounting axis in five (5) degree increments through the terminal connection.
7. Special tools shall not be required for mounting, and service shall be possible without special tools.
8. Attaching visors, back plates, and adapters shall not affect the light and water integrity of the signal.
9. When an optically programmed signal head is used as a side mount signal, the mounting device used shall be an astro-bracket.
10 All vehicle signal red, yellow, and green optically programmable indications shall be of the LED type.

Die cast aluminum parts shall conform with the alloy and tensile requirements, chromate preparatory treatment, and optical black paint requirements in accordance with Chapter 2, Vehicle Traffic Control Signal Heads, ITE publication numbers ST-052 & ST-054, Equipment and Material Standards of the ITE. Hinge and latch pins shall be stainless steel. Finish the exterior of the signal case, lamp housing, and mounting flanges with a high-quality baked enamel primer and finish paint. The signal head, body, doors, visors, and back plates shall be optical black. Seal all access openings with weather resistant rubber gaskets. Provide a drain hole in each head at the lowest point.

Pre-drill the signal case and lens holder to allow installation of back plates and visors. Signal heads shall allow visors to attach using screws such that the installation or removal of the visor does not require modification to the signal head or special tools. Install a cutaway-type visor around each traffic signal module. Back plates shall consist of a one (1) piece, vacuum-formed, ABS plastic plate having a minimum thickness of one-eighth (1/8) inch and a flange wall on all sides with a minimum thickness of five-eighth (5/8) inch. Install back plates in accordance with the manufacturer’s recommendations.
The objective lens shall consist of a high-resolution planer incremental lens hermetically sealed within a flat laminate of weather resistant acrylic. Design the objective lens to allow ninety (90) degree rotation about the optical axis without displacing the primary image.

Design the convex surface of the optical limiter to discretely or integrally incorporate the diffusing element. Provide heat resistant glass and a position indexing means for the optical limiter. Design the optical limiter to focus objects on the optical axis and provide an accessible image to objects within the range of ninety (90) feet to one thousand two hundred (1,200) feet. The optical limiter shall permit the application of an effective veiling mask to determine the visibility zone.

The lamp shall consist of a one-hundred fifty (150) watt sealed beam lamp rated for an average life of at least six-thousand (6,000) hours, and operating at a nominal voltage of one-hundred twenty (120) volts of alternating current (AC). Each lamp shall illuminate only one (1) lens and no indications shall result from any external illumination.

The lamp collar shall consist of an integral lamp support in a separately accessible housing, a quick-release lamp retainer that is self-aligning, and an indexed ceramic socket. Incorporate an interlock assembly that disconnects the lamp holder between the lamp housing and the case. Install terminal blocks on all wire terminations entering the signal. Interconnect all sections using No. 18 AWG stranded and coded wires.

D. Pedestrian Symbols

The minimum symbol height shall be nine (9) inches. Use LED pedestrian "Don't Walk" and "Walk" symbols and LED countdown numerals unless otherwise indicated in the Contract Documents. The Engineer reserves the right to reject a select product or group of products from an LED symbol manufacturer.

E. Pedestrian Signal Housing

Pedestrian signal housing shall be black polycarbonate. Impregnate the coloring into the polycarbonate material such that scratches do not expose non-black material.

F. Pedestrian Pushbutton

Pedestrian pushbuttons shall be black in color and of the type and style indicated in the Contract Documents. House pedestrian pushbuttons in a durable, weather-tight casting. Design the button and mechanisms to withstand abuse and vandalism. Design the internal switching device to close by physical contact with the button. Cover the button with a rubber cover boot. Include pushbutton signs with the push buttons. Supply the type of sign indicated in the Contract Documents, including arrows when directed.

G. Mounting Hardware

Mounting hardware shall be in accordance with the pole manufacturer’s recommendations for the load and type of mounting required.

H. Splice Boxes

Splice boxes shall be in accordance with the applicable NEMA requirements for the installation and use required.
902.03 Construction Requirements

A. General
Refer to Section 900.03 for general construction requirements, in addition to the following requirements.

B. Traffic Signal Installation
Install traffic signals as shown in accordance with the manufacturer’s recommendations and the Contract Documents. Erect each signal assembly to be plumb and securely attached with all fittings tight. Repair any scratches or mars in accordance with the manufacturer’s recommendations. Install all accessories in accordance with the manufacturer’s recommendations. Route the traffic signal and grounding cable to the pole base. Install the traffic signal lamps in a manner to provide maximum brightness and visibility without hotspots.

If the roadway is open to public travel and the erected signal system is not in operation, mask the signals. Cover all inoperative signals on a road open to the public without exception. Upon removal, the covering shall remain the property of the Contractor.

Connect the service neutral conductor and all interconnected equipment grounding solidly to a driven ground rod at the traffic signal service disconnect pedestal. Route service conductors from the power source to the service disconnect then to the controller. Provide a minimum of five (5) feet of excess wire at each end to allow for final connection without splicing.

C. Pedestrian Signal Installation
Install pedestrian signals as shown in accordance with the manufacturer’s recommendations and the Contract Documents. Erect each signal assembly to be plumb and securely attached with all fittings tight. Repair any scratches or mars in the paint in accordance with the manufacturer’s recommendations. Install all signs and accessories in accordance with the manufacturer’s recommendations. Route the pedestrian push button lead-in cable to the pole base.

902.04 Acceptance
The Engineer shall observe the work to check for compliance with the Contract Documents.

902.05 Measurement and Payment
The Engineer shall measure traffic signals for payment by the type of each traffic signal supplied, constructed, and accepted.

The Engineer shall measure pedestrian signals for payment by the type of each pedestrian signal supplied, constructed, and accepted.

The Engineer shall measure pedestrian push buttons for payment by each pedestrian push button supplied, constructed, and accepted.

The following items are considered subsidiary to items for which the Contract provides direct payment: traffic signal design, licenses, or associated permits; tree or shrub trimming; loading, hauling, construction of all materials, pedestrian pushbutton signs and accessories, mounting hardware, grounding rod(s), and miscellaneous hardware; installing wire and/or conduit into an existing base/foundation/pad; and furnishing and installing temporary coverings.
Payment shall be made under the following unless otherwise indicated in the Contract Documents. The Contract Price shall be full compensation for furnishing all labor, materials, equipment, tools, transportation, permits, licenses, and all incidentals necessary to complete the work.

When materials are furnished by the City, delivery of the specific items furnished shall be accepted at the location(s) identified in the Contract Documents. The Engineer shall measure each item furnished by the City for payment of each item installed and accepted.

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Furnish and Install Traffic Signal, Type TS-___</td>
<td>Each</td>
</tr>
<tr>
<td>Install Traffic Signal, Type TS-___</td>
<td>Each</td>
</tr>
<tr>
<td>Furnish and Install Pedestrian Signal, Type PS-___</td>
<td>Each</td>
</tr>
<tr>
<td>Install Pedestrian Signal, Type PS-___</td>
<td>Each</td>
</tr>
<tr>
<td>Furnish and Install Pedestrian Push Button</td>
<td>Each</td>
</tr>
</tbody>
</table>
903 Traffic Signal Controllers

903.01 General
   A. Description
      This work includes furnishing and installing pole-mounted and pad-mounted traffic signal
      controllers, and all other miscellaneous items necessary to provide an operable system as
      indicated in the Contract Documents.
   B. Submittal Requirements
      Refer to Section 900.01 B for submittal requirements.

903.02 Material Requirements
   A. General
      Refer to Section 900.02 for general material requirements, in addition to the following
      requirements.
   B. Traffic Signal Controllers
      Traffic signal controllers shall be in accordance with California Department of Transportation
      (Caltrans) Transportation Electrical Equipment Specification (TEES), dated March 2009, and the
      Contract Documents. Provide all traffic signal controller equipment documentation as indicated
      in the Traffic Signal Equipment Specifications published by the State of California Business,
      Transportation, and Housing Agency.
   C. System Memory Prom Module
      System memory prom modules shall meet the requirements for a Model 170 Traffic Prom
      Module in accordance with Caltrans TEES 2009.

      The entire memory address map shall be user definable to allow for addressing the sockets
      independently. Provide a regulated five (5) volt power supply with a minimum of five-hundred
      (500) milliamps derived from the twelve (12) volt supply on the prom module connector to the
      system memory module. The system memory module shall allow an option to add a lithium
      battery for volatile RAM devices. The module shall operate and inter-mate with the Model 2070
      Controller Unit. Label the front panel to read "System Memory."
   D. Controller
      The controller shall be a Type 2070 Controller, conforming to the Type 2070 Traffic Signal
      Controller Systems – Hardware Specifications, in accordance with the latest version of the State
      of California Transportation Department’s Standard Specifications. Provide a System Memory
      Module with the controller as indicated in the Contract Documents.
   E. Controller Cabinet
      The controller cabinet provided shall be as indicated in the Contract Documents and Standard
      Plates and designed specifically for use with the Type 2070 Traffic Signal Controller. The 332L
      and 336L cabinets shall meet the latest revision of the State of California Transportation
      Department’s Standard Specifications with the following modifications and/or additions. The
      controller cabinet shall be unpainted natural aluminum and equipped with a filtering surge
      protector, EDCO Model 11235 or equivalent. Use a Model PDA-2 power distribution assembly
      or equivalent and a Model 206L twenty-four (24) volt plug in power supply for all controller
      cabinets. Equip the cabinet with a surge suppressor, EDCO Model PC642C008D or equivalent,
and a female terminal connector, Buchanan Series PCB1B or equivalent. The Type 2070 controller shall plug into the one hundred twenty (120) volt power outlet designated for the Type 2070 controller. Equip the controller cabinet with all two-hundred four (204) flashers and flash transfer relays necessary for full operation. Provide a minimum of four (4) red and four (4) yellow flash transfer plugs, including the necessary mounting hardware.

F. **Conflict Monitor – Model 210**

The Model 210 Conflict Monitor shall be compatible with the Type 2070 Traffic Control System and shall be in accordance with Caltrans TEES 2009. The monitor shall identify power problems, brownouts, and power surges.

G. **Switch Pack Model 200 and Flasher Model 204**

The Model 200 Switch Pack Unit and Model 204 Flasher Unit shall be compatible with the Type 170 Traffic Control System and shall be in accordance with Caltrans TEES 2009.

H. **Two Channel Isolators – Model 242 and 252**

Model 242 and 252 Two Channel Isolators shall be compatible with the Type 2070 Traffic Control System and shall be in accordance with Caltrans TEES 2009.

I. **Telephone Lines**

Telephone lines shall be color coded No. 22 AWG six (6) pair cable in accordance with IPCEA and REA Specification PE-39.

### 903.03 Construction Requirements

A. **General**

Refer to Section 900.03 for general construction requirements, in addition to the following requirements.

B. **Traffic Signal Controller Cabinet Installation – Pole-Mounted**

Install the traffic signal controller cabinet at the location indicated in the Contract Documents. Install pole-mounted units in accordance with the pole and cabinet manufacturer's recommendations.

Connect the bottom of 336L pole-mounted cabinets to the signal pole using a three (3) inch Type LB conduit body. Identify and install any holes for the Type LB conduit as necessary. Install the required conduit within the cabinet to be clear of braces and/or equipment to avoid interference with cable runs.

Provide a minimum of twelve (12) inches of slack for all wire and cable, excluding communication cable, installed in a pole-mounted cabinet after making all connections.

C. **Traffic Signal Controller Cabinet Installation – Pad-Mounted**

Install the traffic signal controller cabinet at the location indicated in the Contract Documents. Backfill the excavation and restore the surrounding area disturbed by the pad construction. Backfill shall be in accordance with Section 200.

Dress the top of the concrete pad to provide for proper seating of the controller cabinet base. Heavily coat all areas that contact the concrete foundation on all aluminum bases with an aluminum-filled, resilient sealing compound. Install the controller cabinet in accordance with the manufacturer's recommendations and the Contract Documents.
D. Traffic Signal Controller Installation

Install the Type 2070 Traffic Control System in accordance with the manufacturer’s recommendations. Neatly train all wiring installed inside cabinets. Identify all exiting cables. Ensure that identification is permanent. Indicate the destination loop of traffic signal cables and pedestrian push button cables. Indicate the following on all exiting cables:

1. Function of vehicle destination loop detector lead in cables.
2. Direction of preemption of vehicle preemption cable.
3. Function of overhead vehicle detection cables.
4. Origination direction of communication cable.

Provide a minimum of eighteen (18) inches of slack for all wire and cable, excluding communication cable, pulled into a pad-mounted cabinet after making all connections. All communications cable shall be a minimum four (4) feet long in the cabinet.

E. Telephone Line Installation

Install telephone data and voice lines to the controller cabinet(s) as indicated in the Contract Documents. Install telephone lines inside a two (2) inch diameter PVC conduit from the telephone pedestal to the modem inside traffic signal controller cabinet. Do not splice the telephone line between the telephone pedestal and the telephone modem inside controller cabinet.

903.04 Acceptance

The Engineer shall observe the work to check for compliance with the Contract Documents.

903.05 Measurement and Payment

The Engineer shall measure traffic signal controllers and cabinets for payment by the type of each traffic signal controller and cabinet supplied, installed, connected, and accepted.

The Engineer shall measure leased telephone line for payment by each telephone line installed, connected, and accepted.

The Engineer shall measure telephone risers for payment by each telephone riser installed, connected, and accepted.

The Engineer shall measure telephone drops for payment by each telephone drop installed, connected, and accepted.

The following items are considered subsidiary to items for which the Contract provides direct payment: traffic signal controller design, licenses, or associated permits; tree or shrub trimming; loading, hauling, construction of all materials, mounting hardware, grounding rod(s), and miscellaneous hardware; installing wire and/or conduit into an existing base/foundation/pad; and restoration of the surrounding area.

Payment shall be made under the following unless otherwise indicated in the Contract Documents. The Contract Price shall be full compensation for furnishing all labor, materials, equipment, tools, transportation, permits, licenses, and all incidentals necessary to complete the work.

When materials are furnished by the City, delivery of the specific items furnished shall be accepted at the location(s) identified in the Contract Documents. The Engineer shall measure each item furnished by the City for payment of each item installed and accepted.
<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Install Traffic Signal Controller, Type TC-2070</td>
<td>Each</td>
</tr>
<tr>
<td>Install Leased Telephone Line</td>
<td>Each</td>
</tr>
<tr>
<td>Install Telephone Riser</td>
<td>Each</td>
</tr>
<tr>
<td>Install Telephone Drop</td>
<td>Each</td>
</tr>
</tbody>
</table>
904  Electrical Cable and Duct Installation

904.01  General

A. Description
This work includes the furnishing and installing of electrical cable and duct, and all other miscellaneous items necessary to provide an operable system as indicated in the Contract Documents.

B. Submittal Requirements
Refer to Section 900.01 B for submittal requirements.

904.02  Material Requirements

A. General
Refer to Section 900.02 for general material requirements, in addition to the following requirements.

B. Pull Boxes
Metal pull boxes shall be Class 30 cast iron in accordance with ASTM A48, Standard Specification for Gray Iron Castings. Fiber pull boxes shall be manufactured entirely of polymer concrete (PC) consisting of aggregate bound together with polyester resins and reinforced with woven glass strands of fiber polyester reinforcement or a combination of polymer concrete and structural fiberglass reinforced polymers (FRP) or a combination of polymer concrete and high density polyethylene (HDPE). Design pull boxes to resist damage from prolonged exposure to sunlight, common ice melting chemicals, or fertilizers. Design the pull box and cover to support loading requirements in accordance with AASHTO H-20 and the Contract Documents. Design the cover to fit tightly and prohibit penetration of flowing water. Emboss the cover with an anti-slip surface pattern when indicated in the Contract Documents.

C. Cable Pulling Lubricant
Cable pulling lubricants shall be a commercially available wire pulling compound consisting of soap, talc, mica, or similar materials and designed to have no deleterious effects on the cables being used. Do not use grease or oil type lubricants typically used on lead sheathed cables.

D. Traffic Signal System Cable
1. General Cable: Type 21/C, 16/C, 12/C, 7/C, 5/C
   The traffic signal cable shall be No. 14 AWG solid wire traffic signal cable with the number of conductors as indicated in the Contract Documents. The cables shall, in all respects, be in accordance with the following International Municipal Signal Association (IMSA) specifications:
   - 20-1 General Use
   - 20-3 Aerial Cable
   - 20-5 Direct Burial Cable

2. Grounding Conductor: Type GC
   The grounding conductor shall be No. 8 AWG, type THHN-THWN stranded copper. Splices to the grounding conductor shall be irreversible connections.
3. **Push Button Cable: Type PC**
   The push button lead-in cable shall be No. 16 AWG traffic signal cable with two (2) conductors, in accordance with IMSA Specification 20-1.

4. **Service Cable: Type SC**
   The service cable shall be No. 6 AWG copper type THWN with one (1) conductor, in accordance Section 230 of the National Electrical Code.

5. **Service Entrance Cable: Type SEC**
   The service entrance cable shall be No. 6 AWG copper type THWN with one (1) conductor, in accordance Section 230 of the National Electrical Code.

### 904.03 Construction Requirements

**A. General**

Refer to Section 900.03 for general construction requirements, in addition to the following requirements.

Where new wire is used on a signal project, splices shall not be allowed. If a splice is to be made the Contractor shall notify the Engineer before the splice is made to determine if the wire can be installed without splicing.

All wiring of traffic signal cables shall be in accordance with Standard Plate 904-02. The only exception is any overhead-mounted signal head (regardless of the number of sections) installed over and facing a left turn lane shall have a seven (7) conductor cable installed from the head assembly to the signal pole base, with an extra four (4) feet of cable coiled in the signal base.

Provide and install conductors in the combination mast arm pole and in the luminaire arm, and connect the luminaire head. Connect the conductors in the pole shaft to the 3/C street lighting cable as indicated in the Contract Documents. Terminate the 3/C at the service disconnect pedestal.

**B. Trench Installation**

Excavate the trench to a width equal to or greater than the outer diameter of the conduit along the route indicated in the Contract Documents. The minimum depth of the conduit shall be thirty (30) inches below finished grade unless otherwise indicated in the Contract Documents or directed by the Engineer. The walls and bottom of the trench shall be firm and without excessive dips or pockets. Remove any soft areas or sharp objects and backfill in accordance with Section 200.

**C. Trench-less Installation**

Locate jacking pits a minimum of two (2) feet beyond the edge of pavement. Install conduit by horizontal jacking or boring along the route indicated in the Contract Documents. Do not kink or sharply bend the conduit during installation. Accomplish bending in a manner that does not result in any reduction in cross-sectional area of the conduit.

Replacement of the pavement and backfilling of the trench shall be in accordance with Section 1000 and Section 200, respectively. No separate payment will be made for the removal and replacement of the pavement or backfilling of the trench. In the case of streets and alleys, maintain traffic at all times. In the case of driveways, provide access to the property served by the driveways at all times.
D. Structures
Install conduit in or on bridges, retaining walls, tunnels, and similar structures in accordance with the Contract Documents. Supply special devices or fittings, such as hangers, expansion fittings, deflection fittings, junction boxes, drains, grounding materials, and all other fittings required for conduit systems installed in or on structures.

E. High Density Polyethylene (HDPE) Conduit
HDPE shall only be installed into type PB-6 pull boxes and pad mounted controller cabinets. PVC shall be installed into all other pull box types, signal poles, street light poles, pedestal poles and service disconnect pedestals. HDPE conduit shall only be used for boring installations. When installing HDPE conduit into a type PB-6 pull box or controller pad, the minimum depth of the conduit shall vary from thirty (30) inches at a distance of three (3) feet from the edge of the pull box or controller pad, to eighteen (18) inches at the edge of the pull box or controller pad.

F. Pull Boxes
Construct pull boxes at the location shown in the Contract Documents. Obtain the Engineer’s written approval before installing additional pull boxes to facilitate proper cable installation. Do not construct pull boxes in ditch bottoms, in low areas where water ponding may occur, or where they will be subject to vehicular traffic.

Install preformed expansion joint material between the PCC or pull box and any abutting structure. Position the pull box frame centered in the PCC collar and level with the top of the forms. Install the pull box lid before commencing PCC placement.

Finish the top of the PCC collar to be approximately one-half (½) inch above the adjacent ground unless otherwise indicated in the Contract Documents. Finish the top of the PCC collar to be flush with the surrounding or adjacent sidewalk or pavement elevation when constructing a PCC collar within the limits of a sidewalk. Construct a one-half (½) inch chamfer around all edges exposed to non-paved ground.

Supply and install ground rod(s) at the base of the pull box as indicated in the Contract Documents and in accordance with NEC Article 250.

G. Backfill
Backfill shall be in accordance with Section 200. Replace any pavement or sidewalk removed during installation in accordance with the Contract Documents and Section 1000.

H. Cable Installation – General
Neatly route all cables to their final position. Clearly identify all cables using heat shrink wrapped, stamped metal, or plastic numbered tags. Attach the identification tags to all intermediate points of a cable run within the pull boxes regardless of the presence of a splice. Extend cable outside of transformer bases and pedestal bases a minimum of twenty-four (24) inches before cutting to the proper length. All communications cable in pull boxes, transformer bases, and pedestal bases shall have a minimum of twenty-four (24) inches of slack. All other wire and cable, except ground wire, in pull boxes, transformer bases, and pedestal bases shall have a minimum of eighteen (18) inches of slack.

Construct all connections made at terminal boards and at equipment terminals in accordance with the manufacturer’s recommendations, local codes, and standard electrical practices. Install grounding at pull boxes when indicated in the Contract Documents and as directed by the Engineer.
Splice and joint cables only in pull boxes, pole bases, traffic signal heads, or aerial enclosure. Do not draw a splice or joint inside a conduit. Do not expose a splice or joint to the earth or elements. Perform all splicing in accordance with the cable manufacturer’s recommendations, local codes, and standard electrical practices. Unless otherwise directed by the Engineer, do not use commercially available connector kits for making certain joints. Make the splice by removing the outer sheathing to expose six (6) to twelve (12) inches of wiring conductor. Strip the wiring conductor ends without damaging the wire and remove any contaminants. Do not break the wiring insulation in the process of removing the outer or inner sheathing. Twist the exposed conductors together to form a strong mechanical bond before installing the splice connector. Train the wire splices upward to prevent the entrance of moisture into the connector. Encase all splices in locations susceptible to dampness in a commercially available splicing compound. Splice and terminate fiber optic cable in accordance with the manufacturer’s recommendations using enclosure and termination devices specifically manufactured for fiber optic cable.

The Engineer reserves the right to select splices for thorough inspection. For such inspections, sectionalize the splice or connection to expose the various layers of materials and the connector. Upon completion of the inspection, re-splice or re-connect the wires in accordance with the cable manufacturer’s recommendations, local codes, and standard electrical practices. If more than five (5) percent of the splices or connections inspected fail to conform to the requirements of the Contract Documents, the Engineer will reject all similar splices and connections. Repair any splices or connections that do not conform to the Contract Documents at no additional costs to the City.

I. Cable Installation – Overhead

Before commencing cable installation, provide the Engineer sufficient notice of installation to allow for coordination with utility facilities. Provide and install all devices or fittings required for the overhead cable system. Devices or fittings shall include, but not be limited to, messenger cables, splices, vertical risers, aerial splice boxes, and all hardware necessary for installation in accordance with the cable manufacturer’s recommendations, local codes, and standard electrical practices. Do not allow the cable or messenger to contact anything that is not a designed part of the system. Notify the Engineer and obtain approval before proceeding if installation of the cable messenger requires such contact.

Install expansion loops at each pole or at the entrance and/or exit from all equipment. Tape all cable ends to exclude moisture. Do not remove the tape until splicing or attaching terminals. Transitions from overhead to underground installation shall be in accordance with the Contract Documents.

Provide circuit loading as necessary to provide performance that meets or exceeds Bell System Transmission Specifications for Voice Grade Private Line Data Channels (March 1969) for a Type 3002 unconditioned line for all lines.

Upon completion of the installation, perform testing on the equipment and lines to verify continuity and functional performance. Demonstrate line loss and bandwidth for each cable pair upon request by the Engineer.

J. Cable Installation – Conduit

Install the conduit along the route indicated in the Contract Documents without damaging the conduit. Reroute the conduit to avoid obstructions or other field conditions as directed by the Engineer. Construct all joints and terminations in accordance with the manufacturer’s
recommendations and the National Electric Code. Joints shall be watertight and mechanically sound. Install bushings at all terminations. Remove sharp edges, corners, or burrs that may damage cables. Cap or plug spare conduits using standard fittings. Demonstrate that the installation methods comply with the Contract Documents before commencing conduit installation upon request by the Engineer.

When required, cut the conduit without altering the cross-section. Remove and smooth burrs and sharp edges. Use factory made bends and sweeps whenever possible. Field-bend the conduit to meet existing conditions as directed by the Engineer. Perform field bending using tools and equipment specifically designed and intended for such purpose. Perform bending without creating excessive stresses on the conduit or reducing the cross-sectional area of the conduit. Maximize the radius when bending.

Before installing new cable in existing conduit, remove debris or obstructions from the existing conduit. Demonstrate that the conduit is dry and free of debris by pulling a swab and/or mandrel through the conduit upon request by the Engineer.

Minimize the number of additional bends, conform to the requirements of the National Electric Code, and install the cables without damage to the cable or duct. Install cable in conduit only after the conduit installation is completed.

Install cables using methods that conform to the cable manufacturer’s recommendations and do not result in harmful stretching of the cables or injury to the cable insulation. Furnish written documentation provided by the cable manufacturer detailing the recommending methods of attaching pull cable, pulling tension per size and per radius of conduit bend, and the type of lubricant to be used.

Install all cables in each conduit run simultaneously. Assemble the cables to distribute the pulling tension uniformly to all cables. Grip insulated cables directly by the conductors or by a basket weave pulling grip applied over the cables, depending on the anticipated maximum pulling tension. Use pulling eyes for all long or hard pulls. Remove the insulation from the ends of the wires and form a loop using the conductors. Attach the pull wire or rope to the loop. Use a grip over the insulation in addition to the conductor connection to prevent any slippage of one with respect to the other.

Do not exceed the manufacturer’s recommend maximum pulling tension. When required by the Engineer, install a dynamometer in the pull wire during cable installation to monitor pulling tension. Feed the cable(s) into the conduit from the supply reel without making a reverse curve. Draw the pulling wire and cable(s) in a direct line with the conduit. Use sheaves or other similar devices to reduce any hazards to the cable during installation. Lubricate the cables to reduce friction and minimize potential damage.

K. Cable Installation – Direct Burial

Install the direct burial cable along the route indicated in the Contract Documents. Do not install direct burial cable under a roadway or into a pull box, base, or other structure. Route all cable under a roadway or into a pull box, base, or other structure in conduit installed in accordance with the Contract Documents. Reroute the direct burial cable to avoid obstructions or other field conditions as directed by the Engineer. Un-reel the cable parallel and alongside the trench by moving the reel. Before placing the cable in the trench, verify that the installation depth is a minimum of thirty (30) inches below final grade unless otherwise indicated in the Contract Documents or directed by the Engineer. Place the cable in the trench section by section without dragging or stretching. Do not drag, kink, or otherwise damage the cable during this operation.
904.04 Acceptance

The Engineer shall observe the work to check for compliance with the Contract Documents.

904.05 Measurement and Payment

The Engineer shall measure pull boxes for payment by the type of each pull box supplied, constructed, and accepted.

The Engineer shall measure trenched conduits for payment by the linear feet of the size of conduit supplied, installed, and accepted. The Engineer shall measure conduit installation from the horizontal center to horizontal center of pull box or foundation disregarding any vertical change or splicing.

The Engineer shall measure bored conduits for payment by the linear feet of the size of conduit supplied, installed, and accepted. The Engineer shall measure conduit installation from the horizontal center to horizontal center of pull box or foundation disregarding any vertical change or splicing.

The Engineer shall measure electrical cables or conductors for payment by the linear feet of the type and size of electrical cable or conductor supplied, installed, and accepted. The Engineer shall measure electrical cable or conductor installation from the horizontal center to horizontal center of pull box or foundation disregarding any vertical change, slacking, or splicing.

The following items are considered subsidiary to items for which the Contract provides direct payment: electrical cable and duct design, licenses, or associated permits; tree or shrub trimming and debris or obstruction removal from existing conduit; loading, hauling, construction of all materials, mounting hardware, special devices or fittings, grounding rod(s), and miscellaneous hardware; installing wire and/or conduit into an existing base/foundation/pad; restoration of the surrounding area; and preparing and/or repairing an inspected splice or connection.

Payment shall be made under the following unless otherwise indicated in the Contract Documents. The Contract Price shall be full compensation for furnishing all labor, materials, equipment, tools, transportation, permits, licenses, and all incidentals necessary to complete the work.

When materials are furnished by the City, delivery of the specific items furnished shall be accepted at the location(s) identified in the Contract Documents. The Engineer shall measure each item furnished by the City for payment of each item installed and accepted.

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Furnish and Install Pull Box, Type ___</td>
<td>Each</td>
</tr>
<tr>
<td>Install Pull Box, Type ___ __, ___ Lid</td>
<td>Each</td>
</tr>
<tr>
<td>Furnish and Install ___&quot; Conduit - Trenched</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Furnish and Install ___&quot; Conduit - Bored</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Furnish and Install ___/C No. 14 AWG Traffic Signal Cable</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Furnish and Install ___/C Pair Communication Cable</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Furnish and Install ___/C Detector Lead-In Cable</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Furnish and Install ___/C No. 16 AWG Pedestrian Push Button Lead-In Cable</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Furnish and Install ___/C No. 6 Bare Copper Grounding Conductor</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Furnish and Install ___/C No. 6 Street Lighting Cable</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Furnish and Install Service Entrance Cable</td>
<td>Linear Foot</td>
</tr>
</tbody>
</table>
905 Pavement Markings

905.01 General

A. Description
This work includes furnishing, installing, and/or removing pavement markings, and all other miscellaneous items as indicated in the Contract Documents.

B. Submittal Requirements
Refer to Section 900.01 B for submittal requirements.

905.02 Material Requirements

A. General
Refer to Section 900.02 for general material requirements, in addition to the following requirements.

B. Marking Paint
1. Lane Line Paint
Lane line paint shall meet the requirements of Table 905.01 and Type N paint in accordance with AASHTO M248, Standard Specification for Ready-Mixed White and Yellow Traffic Paints. Determine compliance with Table 906.01 using ASTM D2205, Standard Guide for Selection of Tests for Traffic Paints. White paint coloring shall be pure flat white, free of tint.

<table>
<thead>
<tr>
<th>Table 905.01</th>
<th>Lane Line Paint Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item</td>
<td>White</td>
</tr>
<tr>
<td>Acrylic Emulsion Vehicle Resin Solids, %</td>
<td>43 min.</td>
</tr>
<tr>
<td>pH</td>
<td>9.6 min.</td>
</tr>
<tr>
<td>Fifteen (15) mil Wet Thickness Drying Time at Ninety (90) Percent Relative Humidity, minutes</td>
<td>120.0 max.</td>
</tr>
<tr>
<td>Twelve (12) mil Wet Thickness Contrast Ration, %</td>
<td>96 min.</td>
</tr>
<tr>
<td>Daylight Directional Reflectance, %</td>
<td>83 min.</td>
</tr>
<tr>
<td>Volatile Organic Content, pounds per gallon</td>
<td>1.25 max.</td>
</tr>
<tr>
<td>Track Free Time, minutes</td>
<td>3 max.</td>
</tr>
<tr>
<td>Settling, Rating</td>
<td>6 or Better</td>
</tr>
<tr>
<td>Water Resistant*</td>
<td>Yes</td>
</tr>
</tbody>
</table>
| CIE Chromaticity Limits | x = 0.470 to 0.530  
                          y = 0.429 to 0.483 |

*No blistering or loss of adhesion

Use one-hundred (100) percent acrylic polymer as the vehicle for the paint. Do not use lead, chromate, or other toxic heavy metals in lane line paints. Screen the paint using a No. 40 or finer mesh to remove coarse particles, skins, or other foreign materials.
Each container shall be labeled with the following information:

a. Manufacturer's name and address.
b. Product origin.
c. Trademark or trade name.
d. Paint type and color.
e. Paint formula or manufacturer's formula number.
f. Volume.
g. Batch date and batch or lot number.

2. **Non-Lane Line Paint**

Non-lane line paint shall meet the requirements of Type N paint in accordance with AASHTO M248, Ready-Mixed White and Yellow Traffic Paints, except as modified in Table 905.02. White paint coloring shall match Federal Standard No. 595a, Color 37886. Non-lane line paint shall not discolor or decrease its light-fastness for a minimum period of two (2) years after installation. Use one-hundred (100) percent acrylic polymer as the vehicle for the paint. Do not use lead, chromate, or other toxic heavy metals in non-lane line paints. Screen the paint using a No. 40 or finer mesh to remove coarse particles, skins, or other foreign materials.

<table>
<thead>
<tr>
<th>Non-Lane Line Paint Typical Pigment Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Emulsion HD-21 (49% NV)</td>
</tr>
<tr>
<td>Tamol 901 (30% NV)</td>
</tr>
<tr>
<td>Surfynol CT-136</td>
</tr>
<tr>
<td>Drew L-493</td>
</tr>
<tr>
<td>Ti-Pure R-900</td>
</tr>
<tr>
<td>Omyacarb-5</td>
</tr>
<tr>
<td>Hansa Yellow (11-2400) (75)</td>
</tr>
<tr>
<td>Hansa Yellow (Y1-805) (65)</td>
</tr>
</tbody>
</table>

Mix the above until all the pigment is incorporated; then add:
Table 905.03
Non-Lane Line Paint Additive Formula

<table>
<thead>
<tr>
<th>Material</th>
<th>White</th>
<th></th>
<th>Yellow</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pounds</td>
<td>Gallons</td>
<td>Pounds</td>
<td>Gallons</td>
</tr>
<tr>
<td>Methanol</td>
<td>30.0</td>
<td>4.50</td>
<td>30.0</td>
<td>4.50</td>
</tr>
<tr>
<td>Texanol</td>
<td>23.5</td>
<td>3.00</td>
<td>23.5</td>
<td>3.00</td>
</tr>
<tr>
<td>Drew L-493</td>
<td>3.5</td>
<td>0.49</td>
<td>3.5</td>
<td>0.49</td>
</tr>
<tr>
<td>Natrosol 250 HR (2% aqueous)</td>
<td>8.6</td>
<td>1.03</td>
<td>11.3</td>
<td>1.36</td>
</tr>
<tr>
<td>Preservative*</td>
<td>1408</td>
<td>100</td>
<td>1352.1</td>
<td>100.00</td>
</tr>
</tbody>
</table>

*The manufacturer shall also add a sufficient quantity of a non-mercurial microbicide preservative to prevent growth of microorganisms.


Table 905.04
Non-Lane Line Paint Requirements

<table>
<thead>
<tr>
<th>Item</th>
<th>White</th>
<th></th>
<th>Yellow</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Titanium Dioxide (ASTM D 476 Type II Rutile 92% (\text{TiO}_2) min.)</td>
<td>1 lb/gal min.</td>
<td>0.2 lb/gal min.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimum Density, pounds per gallon</td>
<td>14.00</td>
<td>13.45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dry Opacity, minimum contrast ratio</td>
<td>0.995</td>
<td>0.880</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pigment, % by weight</td>
<td>60.0 to 62.0</td>
<td>56.1 to 58.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consistency, Krebbs, grams</td>
<td>190 to 300</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equivalent K.U.</td>
<td>80 to 95</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum Lead Content, % by weight</td>
<td>0.06</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No-Pick-Up Drying Time, minutes</td>
<td>12.0 max.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dry-Through Drying Time, minutes</td>
<td>120.0 max.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Track-Free Field Drying Time, minutes</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pH</td>
<td>9.8 min.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum Volatile Organic Content, grams per liter</td>
<td>115</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimum Closed Cup Flash Point, Fahrenheit</td>
<td>115</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Solids</td>
<td>77.0</td>
<td>76.1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Each container shall be labeled with the following information:

a. Manufacturer's name and address.
b. Product origin.
c. Trademark or trade name.
d. Paint type and color.
e. Paint formula or manufacturer's formula number.
f. Volume.
g. Batch date and number.
C. Glass Beads

Glass beads for use in lane line and non-lane line painting shall conform to the requirements for Type 1 Glass beads in accordance with AASHTO M247, Glass Beads Used in Traffic Paints, except a minimum of eighty (80) percent shall be true spheres. Treat the beads with a moisture resistant silicone treatment and a silane adherence surface treatment.

Supply the glass beads in fifty (50) pound or two-thousand (2,000) pound waterproof and leak-proof containers. Each container shall be labeled with the following information:

1. Manufacturer's name and address.
2. Trademark or trade name.
3. Batch and packaging date.
4. Weight.
5. Lot Number.

Keep the beads dry at all times.

D. Preformed Tape

Preformed tape shall be manufactured by 3M and be in accordance with the Contract Documents. The manufacturer shall guarantee the adhesion and reflectivity after initial installation for a period of four (4) years for longitudinal preformed tape and a period of two (2) years for preformed tape symbols.

E. Preformed Tape Primer

Preformed tape shall be installed with the recommended primer from the tape manufacturer before May 15th and after September 15th, or as recommended by the preformed tape manufacturer, whichever is more stringent.

905.03 Construction Requirements

A. General

Refer to Section 900.03 for general construction requirements, in addition to the following requirements.

Obtain all licenses and permits before commencing the work. The pavement marking installer shall be certified by the manufacturer and shall perform all installations. Installations shall be in accordance with all applicable sections of the Manual on Uniform Traffic Control Devices, all governing local ordinances and regulations, and the Contract Documents.

The Contractor shall maintain a minimum of two (2) open lanes of traffic on one-way streets and one (1) open lane of traffic in each direction on two-way streets during the work, unless otherwise indicated in the Contract Documents. Open all lanes to traffic during peak hours as directed by the Engineer or Contract Documents. Maintain traffic through open intersections at all times.

B. Equipment

A water blaster with pressure adjustment controls shall be used to remove existing or temporary markings. The water blaster shall not damage the pavement.

Equipment for installing painted markings shall consist of, but not be limited to, a surface cleaning machine, a mechanical marking machine, a bead dispensing machine, and any hand equipment necessary to perform the work. The mechanical marking machine shall be an airless
spray-type machine designed for the application of marking paint. The mechanical marking machine shall produce a uniform film thickness at the specified coverage.

Equipment for grooving of pavement shall be a machine equipped with stacked diamond cutting heads and a vacuuming system as recommended by the preformed marking tape manufacturer. The grooving machine shall provide a uniform finished surface as recommended by the preformed marking tape manufacturer.

C. Marking Removal

The Contractor shall remove conflicting markings in accordance with the Contract Documents or as directed by the Engineer. Remove markings without altering or damaging the pavement surface or texture. Preserve the color and texture of the adjoining pavement.

D. General Marking Installation

Install pavement markings at the locations indicated in the Contract Documents and in accordance with the Manual of Uniform Traffic Control Devices. Remove old markings and place new markings before shifting or adjusting traffic patterns. Notify the Engineer immediately of any conflicting markings. Remove any residue after installation that may interfere with drainage, pollute the environment, or create a traffic hazard.

E. Temporary Paint Markings

The Contractor shall install temporary paint markings as indicated in the Contract Documents or as directed by the Engineer. This work shall consist of placement of white or yellow paint with embedded glass beads for retroreflectivity. Temporary paint that fails to provide a uniform appearance, or which fails to be clearly visible during the day or night shall be corrected or replaced by the Contractor at no additional cost to the City. Apply temporary paint at a minimum rate of two-hundred eighty (280) square feet per gallon. Apply glass beads for all temporary paint markings at a minimum rate of four (4) pounds per gallon of paint using a bead-dispensing machine. Attach the bead-dispensing machine to the painting machine in accordance with the manufacturer's recommendations.

Maintain all temporary paint markings during construction as directed by the Engineer. The Engineer reserves the right to suspend the work for failure to provide or maintain temporary paint markings.

Temporary marking tape may be substituted for temporary paint upon written approval of the Engineer, but there will be no cost adjustment for such substitution.

F. Permanent Paint Markings

Clean the surface prior to permanent paint marking installation. Lay out the markings before commencing installation of paint markings. Use non-lane paint for crosswalks, stop bars, island noses, hatching, or as directed by the Engineer. Mix the paint in accordance with the manufacturer's recommendations. Apply the paint to a dry surface and in accordance with the manufacturer’s recommended surface temperatures and atmospheric conditions. Apply paint with a uniform cross section and clear-cut edges without running, spattering, or over-spray, and along the lines indicated in the Contract Documents. Do not use paint thinner or other chemicals to alter the paint composition. Apply permanent paint at a minimum rate of one hundred fifteen (115) square feet per gallon.

Apply glass beads for all permanent paint markings at a rate of seven (7) pounds per gallon of paint using a bead-dispensing machine. Attach the bead-dispensing machine to the painting
machine in accordance with the manufacturer’s recommendations. Cease painting operations if the glass beads do not adhere to the cured paint.

G. Permanent Preformed Tape Markings
Lay out the markings before commencing installation of preformed tape. Preformed tape markings shall be installed in grooved channels or recesses in rigid or existing flexible pavements as recommended by the manufacturer. Grooving is not required for installations during the construction of flexible pavement, provided the tape is installed immediately after flexible pavement placement.

Locate the groove two (2) inches from a construction joint in the pavement surface. Limit the grooving width to one (1) inch greater than the preformed tape for lane line markings. Grooves shall conform to the requirements of Table 905.05. Accomplish lane line grooving in one (1) pass of the grooving machine.

<table>
<thead>
<tr>
<th>Item</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groove Width</td>
<td>Tape Width + 1 inch</td>
</tr>
<tr>
<td>Groove Depth</td>
<td>50 mils ± 10 mils</td>
</tr>
<tr>
<td>Groove Length</td>
<td>Tape Length + Grooving Transition</td>
</tr>
</tbody>
</table>

Grooving equipment shall leave the grooved surface ready for preformed tape installation. Grooves shall be clean and dry before tape application. Apply the preformed tape using manual or automatic equipment. Place the preformed tape in the grooves the same day as constructing the grooves. Use application equipment capable of cutting the preformed tape to the proper length. Place parallel centerlines simultaneously and five (5) inches apart unless otherwise indicated in the Contract Documents. Roll the preformed tape with a steel drum roller to seat the tape on the underlying surface. The size of the roller shall be sufficient to seat the tape.

Install preformed tape markings in accordance with the manufacturer’s recommendations. Preformed tape markings shall be installed with primer before May 15th and after September 15th, or as recommended by the preformed tape manufacturer, whichever is more stringent.

Remove any conflicting markings as directed by the Engineer.

905.04 Acceptance
The Engineer shall observe the work to check for compliance with the Contract Documents. The Contractor shall take periodic measurements to verify the thickness and width of the installed markings.

Remove and replace any markings if the center or edge of the marking deviates from the dimensions indicated in the Contract Documents by more than one-half (½) inch in fifty (50) feet. The Engineer shall observe all markings for a period of thirty (30) days after opening pavement for normal traffic before final acceptance of all markings. Final acceptance of all markings will include an inspection of the appearance of the markings during daylight and darkness. Remove and replace any marking(s) performing unsatisfactorily due to defective materials and/or application, as determined by the Engineer, at no additional cost to the City.
905.05 Measurement and Payment

Glass beads will not be paid for directly but shall be subsidiary to items for which the Contract provides direct payment.

The Engineer shall measure removal of marking lines for payment by the linear feet of marking line removed, disposed of, and accepted.

The Engineer shall measure removal of marking symbols for payment by each marking symbol removed, disposed of, and accepted.

The Engineer shall measure installation of temporary paint markings for payment by the linear feet of the width and color of temporary paint marking supplied, installed, and accepted.

The Engineer shall measure permanent paint markings for payment by the linear feet of the type of permanent paint marking supplied, installed, and accepted.

The Engineer shall measure permanent preformed tape markings for payment by the linear feet of the type of permanent preformed tape markings supplied, installed, and accepted. Grooving of pavement shall be subsidiary to items for which the Contract provides direct payment.

The Engineer shall measure permanent preformed tape symbols for payment by the type of each permanent preformed tape symbol supplied, installed, and accepted. Grooving of pavement shall be subsidiary to items for which the Contract provides direct payment.

The Engineer shall measure permanent preformed tape symbols for payment by the square feet of the type of permanent preformed tape symbol supplied, installed, and accepted. Grooving of pavement shall be subsidiary to items for which the Contract provides direct payment.

The Engineer shall measure installation of City-furnished preformed tape symbols for payment by the type of each preformed tape symbol installed and accepted. Grooving of pavement shall be subsidiary to items for which the Contract provides direct payment.

The following items are considered subsidiary to items for which the Contract provides direct payment: removal of temporary paint or tape markings, conflicting paint or tape markings, and/or existing paint or tape markings, as necessary; pavement markings design, licenses, or associated permits; and loading, hauling, construction of all materials and miscellaneous.

Payment shall be made under the following unless otherwise indicated in the Contract Documents. The Contract Price shall be full compensation for the cost for grooving, furnishing and installing the pavement markings, beads, and primer; and for furnishing all labor, materials, equipment, tools, transportation, permits, licenses, and all incidentals necessary to complete the work.

When materials are furnished by the City, delivery of the specific items furnished shall be accepted at the location(s) identified in the Contract Documents. The Engineer shall measure each item furnished by the City for payment of each item installed and accepted.
<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remove Marking Lines</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Remove Marking Symbols</td>
<td>Each</td>
</tr>
<tr>
<td>Temporary Paint Marking – ___</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Permanent Paint Marking – ___</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Permanent Preformed Tape Marking – ___</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Permanent Preformed Tape Symbol – Type ___</td>
<td>Each</td>
</tr>
<tr>
<td>Permanent Preformed Tape Symbol – Type ___</td>
<td>Square Foot</td>
</tr>
<tr>
<td>Install (City Furnished) Permanent Preformed Tape Symbol – Type ___</td>
<td>Each</td>
</tr>
</tbody>
</table>
906  Traffic Control Devices

906.01  General
A. Description
This work includes supplying and/or erecting devices for temporary and permanent traffic control in accordance with the Contract Documents, the Manual of Barricading Standards, Specifications, Methods, and Materials for the City of Omaha, or as directed by the Engineer.

B. Submittal Requirements
Refer to Section 900.01 B for submittal requirements.

906.02  Material Requirements
A. General
Refer to Section 900.02 for general material requirements, in addition to the following requirements.

B. Signs, Barricades, and Advance Warning Systems
Signs, barricades, and advance warning systems shall be in accordance with the current edition of the Manual for Uniform Traffic Control Devices for the type and size indicated in the Contract Documents. Signs shall be flat, 6061-T6 aluminum in accordance with ASTM B221, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

C. Temporary Sign Drums
Drums used for temporary signs shall be approximately three (3) feet high and a minimum of eighteen (18) inches in diameter. Mark the drums using four (4) to eight (8) inch wide white and orange reflective horizontal sheeting. Alternate the reflective sheeting colors. The reflective sheeting shall display the same approximate size, shape, and color in the day or night.

D. Fiber Optic Blank-Out Sign
House fiber optic blank-out signs using a black housing thirty (30) inches wide and thirty-six (36) inches high manufactured by National Sign & Signal Company or equivalent. Attach a black visor to the top and sides of the sign. The minimum depth of the visor shall be seven (7) inches. Supply all necessary mounting hardware for the mounting location(s) indicated in the Contract Documents.

Each pixel point bundle shall have a minimum tip diameter of sixty-eight-thousandth (0.068) inch. The maximum spacing between pixel point bundles shall be one-half (½) inch. Use a minimum of four (4) light sources to illuminate the fiber optic sign message. Cover or house fiber bundles interior to the front sign panel to conceal these bundles when the sign housing is opened for light source replacement. Do not conceal the light sources. Fiber shall be glass. Do not use synthetic fiber. Provide two (2) replacement light sources for each sign installed.

E. LED Blank-Out Sign
House LED blank-out signs using a black housing thirty (30) inches wide and thirty-six (36) inches high manufactured by National Sign & Signal Company or equivalent. LED blank-out signs shall use white LED lighting. Attach a black visor to the top and sides of the sign. The minimum depth of the visor shall be seven (7) inches. Supply all necessary mounting hardware for the mounting location(s) indicated in the Contract Documents.
F. Sign Lighting Equipment

Sign lighting equipment luminaire housing shall be weather-tight, have adequate mounting for sign lighting, and accommodate a one-hundred seventy-five (175) watt mercury vapor lamp. The luminaire shall have a maximum foot-candle uniformity ratio of five (5) to one (1) and minimum reading of ten (10) foot-candles with the luminaire mounted as indicated in the Contract Documents over an eight (8) foot wide by six (6) foot high sign. Design the mounting to allow positioning of the luminaire between thirty (30) and sixty (60) inches from the face of the sign.

The ballast for the luminaire shall be a high power factor, regulated output type. House the ballast in a weather-tight enclosure located on the main chord of the truss. Submit a production model luminaire of the type proposed for use to the Engineer before ordering luminaires for the project. Submittal of pre-approved models is not required. The Engineer shall return the submitted luminaire to the Contractor after completing the inspection.

The photoelectric control shall be a cadmium sulfide type providing an operating range of one (1) to three (3) foot-candles. The units shall operate at a voltage of one-hundred twenty (120) volts AC at temperatures of minus twenty (–20) to one-hundred twenty (120) degrees Fahrenheit. It shall include an integral lightning arrestor and be equipped to mount in a standard three-prong (3-prong) twist-lock receptacle. It shall be complete with the necessary pole top mounting accessories. Provide secondary relays for switching the 120/240 line voltage to the lighting fixtures. Mount the relays in separate rain-tight housing.

G. Square Tubular Posts

Square tubular posts shall be twelve (12) gauge, four (4) pounds per foot, cold-rolled steel in accordance with ASTM A653, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process. Use twelve (12) gauge, two and one-half (2½) pounds per foot, cold-rolled steel posts when indicated in the Contract Documents or as directed by the Engineer. Punch evenly spaced holes for the full length of the post before rolling. Use a punching process that does not create cracking around the holes. Roll the post to have a square cross section and welded corners when indicated in the Contract Documents. The weld flash shall allow the placement of a nine-sixty-fourth (\(\frac{9}{64}\)) inch radius gage in the welded corner. Consecutive size posts shall allow ten (10) feet of telescoping. Supply posts one and seven-eighth (1\(\frac{7}{8}\)) to two and one-eighth (2\(\frac{1}{8}\)) inches longer than the length indicated in the Contract Documents. Square tubular posts shall meet the requirements of Table 906.01.
Table 906.01
Square Tubular Post Requirements

<table>
<thead>
<tr>
<th>Allowable Tolerances</th>
<th>Nominal Outside Dimension (inch)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1¾&quot; x 1¾&quot;</td>
</tr>
<tr>
<td>Outside Measurement All Sides at Corners</td>
<td>± 0.008&quot;</td>
</tr>
<tr>
<td>Squariness of Sides</td>
<td>±0.0100&quot;</td>
</tr>
<tr>
<td>Side Twist in 3 Feet</td>
<td>0.0620&quot; max.</td>
</tr>
<tr>
<td>Wall Thickness</td>
<td>- 0.008&quot; to +0.011&quot;</td>
</tr>
<tr>
<td>Convex or Concavity at the Center of Flat Sides</td>
<td>0.0100&quot; max.</td>
</tr>
<tr>
<td>Straightness Deviation in 3 Feet</td>
<td>0.0625&quot; max.</td>
</tr>
<tr>
<td>Corner Radius</td>
<td>0.15625&quot; ± 10%</td>
</tr>
<tr>
<td>Hole Size</td>
<td>0.4375&quot; ± 0.015625&quot;</td>
</tr>
<tr>
<td>Hole Spacing</td>
<td>1.0000&quot; ± 0.125&quot; on center</td>
</tr>
</tbody>
</table>

H. Steel U-Posts

 Manufacture steel U-posts in accordance with ASTM A499, Standard Specification for Steel Bars and Shapes, Carbon Rolled from "T" Rails. Steel U-posts shall have a uniform channeled cross section. The outside dimension of the channel base shall be three (3) to three and one-fourth (3¼) inches wide. Punch three-eighth (3⁄8) inch diameter holes along the bottom of the channel throughout the full length of the sign post. Evenly space the holes one (1) inch on center in the center of the channel bottom. Center the holes along the middle of the channel bottom width. The maximum allowable deviation from the required positioning is one-sixteenth (1⁄16) inch.

I. Yielding Post Support Structure


J. Fasteners and Mounting Hardware

 Sign fasteners and mounting hardware shall be rust resistant. Bolts for use on square tubular posts shall be 5/16-18 angle bolts manufactured by Unistrut Corporation or equivalent. All other bolts shall be 5/16-18 zinc plated Whiz-Lock bolts manufactured by Maclean-Fogg Company or equivalent. Fasteners for holding signs to square tubular posts shall be reusable.

 Banding shall be stainless steel straps, three-fourth (¾) inch wide, with a minimum thickness of twenty-thousandths (0.020) inch. Banding seals shall be Band-It C 163 or equivalent.

 Sign brackets for use with banding shall be Band-It D0-22 galvanized brackets or equivalent. Cantilever sign brackets for street name signs shall be Model Number VSS-1C manufactured by Vulcon Signs and Stamping, Inc. or equivalent.

K. Steel Sign Brackets

 Steel sign brackets shall be fabricated from structural steel in accordance with ASTM A36, Standard Specification for Structural Steel, with a maximum working stress of twenty-thousand (20,000) pounds per square inch.
906.03  Construction Requirements

A. General

Refer to Section 900.03 for general construction requirements, in addition to the following requirements.

The Contractor shall be responsible for installing, maintaining, and removal of temporary traffic control devices for the duration of the project. No work shall commence until temporary traffic control devices have been set, and work may be stopped by the Engineer if temporary traffic control devices are found to be improperly maintained.

B. Sign Fabrication

Degrease aluminum by totally immersing the metal in a saturated vapor of trichloroethylene or perchloroethylene or in a tank containing alkaline solutions. Control and titrate the alkaline solutions in accordance with the manufacturer’s recommendations. Rinse alkaline soak metals with running water.

Acid etch the metal using a six (6) to eight (8) percent phosphoric acid or other acid etching solution at one-hundred (100) degrees Fahrenheit. Thoroughly rinse the metal using cold running water, then hot running water if desired. Dry the metal using a forced hot air dryer. Do not allow the metal to contact grease, oils, or other contaminants before applying the reflective sheeting.

The sign face shall be in accordance with the Manual of Uniform Traffic Control Devices. Apply reflective sheeting or paint in accordance with the manufacturer’s recommendations. Match multiple piece signs before applying the reflective sheeting or paint to provide uniformity. Signs with mismatched background color of adjacent sheets or panels are not acceptable.

Age the reflective sheeting for forty-eight (48) hours at seventy-five (75) degrees Fahrenheit. Continue aging if the reflective sheeting strips from the panel using a stiff putty knife.

Apply the legend and border using a direct-screened or reverse-screened process. The direct-screened process shall consist of the screen process method. Use a process color material and obtain a dry film thickness in accordance with the reflective sheeting or paint manufacturer’s recommendations. The reverse-screen process shall consist of processing an opaque or transparent color over the sign face. Use an opaque or transparent process color material and obtain a dry film thickness in accordance with the reflective sheeting or paint manufacturer’s recommendations.

C. Temporary Traffic Control Devices

1. General

Erect temporary traffic control devices in accordance with the Contract Documents, the Manual of Barricading Standards, Specifications, Methods, and Materials for the City of Omaha (Barricading Manual), and as directed by the Engineer. Construction-related signage shall utilize fluorescent orange sheeting. All lane and street closures shall follow the procedures described in the Barricading Manual. Procedures shall include, but are not limited to, standard notifications given to City personnel, press releases, message boards in place a minimum of one (1) week before work begins, detour routes posted, agency identification signs installed, and maintenance of devices during the project. Arrow panels
shall be used on streets as indicated in the Contract Documents and the Barricading Manual.

Unless otherwise indicated in the Contract Documents, the Contractor shall be responsible for providing and maintaining detours around the Work. All detour routes shall be submitted to the Engineer for approval prior to the posting of detour routes.

The Contractor shall provide access to local traffic within the project in accordance with the Contract Documents or as directed by the Engineer. The Contractor is responsible for maintaining any temporary approaches or crossings at no cost to the City unless otherwise indicated in the Contract Documents.

2. Barricades

Erect temporary barricades in accordance with the Standard Plates, the Barricading Manual, the Contract Documents, and as directed by the Engineer.

Temporary barricades erected for intermittent construction operations to restrict a traffic lane shall be removed at the end of each day. This procedure shall include, but is not limited to, construction operations such as sodding, seeding, landscaping, watering, irrigation system installation, traffic signals, and traffic signs. The Contractor shall be responsible for having the temporary lane restrictions in place before work begins. The Contractor shall be responsible for having the restricted lanes cleaned of any debris, material, and equipment before the lane restrictions are removed at the end of each day. All lane restrictions shall be in accordance with the Barricading Manual. The cost to place and remove barricades for intermittent construction operations shall be subsidiary to items for which the Contract provides direct payment.

Maintain a minimum of two (2) lanes of traffic on one-way streets and one (1) lane of traffic in each direction on two-way streets open to traffic during the work. Open all lanes to traffic during peak hours as directed by the Engineer or Contract Documents. Maintain traffic through open intersections at all times.

3. Temporary Sign Post Installation

Install temporary sign posts in accordance with the Standard Plates, the Barricading Manual, the Contract Documents, and as directed by the Engineer. Attach a two (2) foot U-post vertically to the inside of the drum and bolt to a U-post with the required sign(s) on the outside of the drum. Position the drum and sign and fill with a minimum of one-hundred fifty (150) pounds of aggregate.

4. Maintenance

The Contractor shall protect the work and the safety of the public. Maintain temporary traffic control devices in accordance with the Barricading Manual. The Contractor shall take immediate action to correct any deficiencies in the placement and maintenance of all temporary traffic control devices. The Contractor shall inspect temporary traffic control devices a minimum of once a week for every week the devices are in use, but shall perform more frequent inspections during or following periods of inclement weather or as directed by the Engineer. The Contractor may be given notice, either written or verbal, of failure to install, replace, remove, and/or maintain a temporary traffic control device. Failure to install, replace, remove, or maintain a device within eight (8) hours of the initial notice may result in no payment being made for any temporary traffic control devices on the project for that day and on subsequent days until the requested installation, replacement,
removal, or maintenance is performed. The Engineer may also suspend all other work until
the problem is corrected.

Maintenance shall include, but be not limited to, repositioning and re-erecting devices that
have been moved, replacing damaged or deteriorated devices, cleaning mud and debris
from devices, controlling surrounding vegetation growth, storing equipment and materials
so as to not obscure devices, replacing batteries in flashing warning lights, and replacing
sandbags or otherwise maintaining anchoring devices.

5. Flagging

The Contractor shall furnish flagger(s) to direct traffic when construction activity occurs on
or adjacent to a surface being used by the traveling public. Except when necessitated by
an emergency or for situations not reasonably expected to last for more than fifteen (15)
minutes, flagging shall not be performed by other than certified flaggers. The flagger(s)
shall be attired with vest and head gear, provided advance warning signs, and be otherwise
equipped in accordance with the standards established by the State of Nebraska
Department of Transportation (NDOT). Flaggers shall be familiar with the contents of the
NDOT’s “Flaggers Handbook” and shall carry a copy of such publication on their person
while performing flagger duties.

Flaggers shall carry a valid Flagger Certification Card. Flagger Certification Cards shall be
valid for a period of two (2) years from date of issue. The Contractor shall be responsible
for training and certification of the flaggers employed on the project. Certification shall be
in accordance with the standards established by the NDOT. Upon satisfactory completion
of the training and examination procedure, the prospective flagger shall be issued a Flagger
Certification Card by the examining Contractor. The flagger’s name, social security number,
and test score shall be submitted to the Engineer.

D. Permanent Traffic Control Devices

1. Permanent Sign Post Installation

Install permanent sign posts in accordance with the Standard Plates and the Manual of
Uniform Traffic Control Devices, and at the location(s) indicated in the Contract Documents
or as directed by the Engineer. Install posts in PCC using a V-Loc Socket System Anchor or
equivalent. Grout the posts into the surrounding PCC. Crown the surface of the grout to
shed water away from the post.

Drive posts a minimum of three (3) feet into the ground. Driven posts shall be
perpendicular to the longitudinal slope of the roadway.

Handle and erect posts in a manner that prevents damage to the posts. Replace any
damaged posts at no additional cost to the City.

2. Permanent Sign Installation

Install permanent signs in accordance with the Standard Plates and the Manual of Uniform
Traffic Control Devices, and at the location(s) indicated in the Contract Documents or as
directed by the Engineer.

The minimum mounting height shall be seven (7) feet. Use a minimum mounting height of
six (6) feet for secondary signs mounted below another sign. Orient all signs, except
parking control signs, at a ninety (90) degree angle with the roadway edge. Orient parking
control signs with arrows at a forty-five (45) degree angle with the roadway edge. Erect
signs vertical and oriented to maximize effectiveness in day and night conditions. Avoid
orienting signs to avoid the possibility of specular reflections. Maintain a minimum clearance of seventeen (17) feet above the crown of the roadway for overhead sign installations.

Handle and erect signs in a manner that prevents damage to the signs. Replace any damaged signs at no additional cost to the City.

906.04 Acceptance

The Engineer shall observe the work to check for compliance with the Contract Documents.

Acceptance shall include maintenance of temporary traffic control devices during construction of the project. Temporary traffic control devices shall be reviewed by the Contractor for maintenance weekly, or more frequently when directed by the Engineer. Signs and barricades which are not kept clean and positioned will not be accepted for payment.

906.05 Measurement and Payment

The Engineer shall measure installation of overhead signs provided by the City for payment by a lump sum of the overhead sign(s) installed and accepted.

The Engineer shall measure installation of posts and signs provided by the City for payment by a lump sum of the post(s) supplied, installed, and accepted, and the traffic sign(s) installed and accepted.

The Engineer shall measure installation of posts and traffic signs for payment by a lump sum of the post(s) and traffic sign(s) supplied, installed, and accepted.

The Engineer shall measure furnishing a changeable message sign for payment by the calendar days of the message sign provided, operated, maintained, removed, and accepted.

The Engineer shall measure furnishing a flashing arrow panel for payment by the calendar days of the arrow panel provided, operated, maintained, removed, and accepted.

The Engineer shall measure permanent sign days for payment by the calendar days of the permanent sign provided, installed, maintained, removed, and accepted. Sign support shall be considered subsidiary to other items for which the Contract provides direct payment.

The Engineer shall measure temporary sign days for payment by the calendar days of the temporary sign provided, installed, maintained, removed, and accepted. Sign support shall be considered subsidiary to other items for which the Contract provides direct payment.

The Engineer shall measure barricades for payment by the number of calendar days of the type of barricade provided, installed, maintained, removed, and accepted.

The Engineer shall measure providing temporary traffic control per street segment for payment by the calendar days of temporary traffic control devices furnished, erected, maintained, removed, and accepted. Individual traffic control devices will not be measured separately. The quantity of traffic control devices required shall include, but not be limited to, the type and number of devices shown on any detour and/or barricade plan(s) in the Contract Documents, and additional traffic control devices as directed by the Engineer.

The Engineer shall measure providing temporary traffic control per intersection corner for payment by the calendar days of temporary traffic control devices furnished, erected, maintained, removed, and accepted. Individual traffic control devices will not be measured separately. The quantity of traffic control devices required shall include, but not be limited to, the type and number of devices
shown on any detour and/or barricade plan(s) in the Contract Documents, and additional traffic control devices as directed by the Engineer.

The Engineer shall measure providing flaggers for payment on a daily basis for each flagger location. Operation of one flagger for four (4) hours or less will be considered as a half day and operation for more than four (4) hours will be considered as a full day. This price shall be full compensation for furnishing properly trained, attired, and equipped flaggers, and for furnishing, installing, maintaining, and removing temporary signs for each flagger location.

Permanent sign days, temporary sign days, and barricade days will be calculated by the number of signs and/or barricades multiplied by the calendar days the signs and/or barricades are in place. Signs and barricades will not be paid for after the specified date for completion of the Work.

The following items are considered subsidiary to items for which the Contract provides direct payment: traffic control device design, licenses, or associated permits; tree or shrub trimming; loading, hauling, construction of all materials, mounting hardware, grounding rod(s), and miscellaneous hardware; installing wire and/or conduit into an existing base/foundation/pad; and restoration of the surrounding area.

Payment shall be made under the following unless otherwise indicated in the Contract Documents. The Contract Price shall be full compensation for furnishing, fabricating and attaching the sign or sign assemblies to the sign post(s) or structure(s); including the furnishing of the aluminum sign blanks, furnishing and applying the finish material to the sign face, process material and screens for processing and processing the legend and border on the sign face and furnishing all sign posts, anchor posts, yielding structural support, bolts, nuts, mounting hardware for attaching sign or sign assembly to sign post(s) or structure(s); and for furnishing all labor, materials, equipment, tools, transportation, permits, licenses, and all incidentals necessary to complete the work.

When materials are furnished by the City, delivery of the specific items furnished shall be accepted at the location(s) identified in the Contract Documents. The Engineer shall measure each item furnished by the City for payment of each item installed and accepted.

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Install Overhead Signs, Signs Provided By City</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>Install Traffic Posts and Signs, Signs Provided By City</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>Install Traffic Posts and Signs</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>Changeable Message Sign</td>
<td>Day</td>
</tr>
<tr>
<td>Flashing Arrow Panel</td>
<td>Day</td>
</tr>
<tr>
<td>Permanent Sign Day</td>
<td>Day</td>
</tr>
<tr>
<td>Temporary Sign Day</td>
<td>Day</td>
</tr>
<tr>
<td>Type ___ Barricade</td>
<td>Barricade-Day</td>
</tr>
<tr>
<td>Provide Temporary Traffic Control Per Street Segment</td>
<td>Barricade-Day</td>
</tr>
<tr>
<td>Provide Temporary Traffic Control Per Intersection Corner</td>
<td>Barricade-Day</td>
</tr>
<tr>
<td>Provide Flagger</td>
<td>Day</td>
</tr>
</tbody>
</table>
907 Service Disconnects

907.01 General
   A. Description
   This work includes furnishing and installing a traffic signal system service disconnect pedestal for permanent construction or a service disconnect switch for temporary construction, and all other miscellaneous items necessary to provide an operable system as indicated in the Contract Documents.

   B. Submittal Requirements
   Refer to Section 900.01 B for submittal requirements.

907.02 Material Requirements
   A. General
   Refer to Section 900.02 for general material requirements, in addition to the following requirements.

   B. Service Enclosure
   The service enclosure shall be Tesco Class 26-100-UM-A or equivalent, and shall be in accordance with UL 508, Industrial Control Equipment. Fabricate the exterior of the service enclosure using one-eighth (\(\frac{1}{8}\)) inch aluminum. Fabricate the interior of the service enclosure using fourteen (14) gauge, cold-rolled steel. Paint the interior of the service enclosure white. The interior dimensions of the service enclosure shall be twelve (12) inches wide, forty-three (43) inches high, and seven and one-half (7\(\frac{1}{2}\)) inches deep. The service enclosure shall have continuously welded seams, a full-length deadfront with stainless steel hinge, and a pull section with a removable step.

   The service enclosure shall have a fully framed, side-hinged, swaged outer door, flush fitted with top drip lip and closed cell neoprene flange-compressed gaskets. The service enclosure shall have a hinged deadfront with a one-fourth (¼) turn latch and knurled knobs. Hinge the deadfront door on the same side as the exterior door. The deadfront door shall open a minimum of one-hundred (100) degrees. Mount a removable backpan on four (4) welded one-fourth (¼) inch studs. The service enclosure shall be completely pre-wired in the factory. Provide a generator transfer switch when indicated in the Contract Documents. Bolt-on or plug-in circuit breakers are not acceptable.

   The service enclosure manufacturer shall furnish independent laboratory certification that the metal preparation, the finish, and the overall product comply with the Contract Documents. The Engineer reserves the right to require and witness compliance testing.

   C. Service Disconnect Switch Enclosure
   Service disconnect switch enclosures for temporary applications shall be in accordance with a NEMA Type 3R enclosure, service rated, and sixty (60) amp fused.

   D. Wiring Schematics
   Produce wiring schematics using drafting software. Include all external equipment and connections in accordance with NEMA II B. Enclose as-built factory drawings in clear plastic. Store drawings inside the outer door using welded hooks.
E. Service Conductors
Service conductors shall be in accordance with National Electrical Code Section 230, Services.

F. Wood Post
Wood posts shall be in accordance with AASHTO Publication LTS-5, Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals.

907.03 Construction Requirements

A. General
Refer to Section 900.03 for general construction requirements, in addition to the following requirements.

Identify the location of the permanent disconnect and obtain approval from the Engineer before commencing construction of the foundation.

B. Permanent Service Disconnect Switch Installation
If the location of the service disconnect pedestal is not indicated in the Contract Documents, it shall be field located within fifty (50) to one-hundred (100) feet of the traffic signal controller cabinet in line between the controller cabinet and power source. In order to arrange to have a representative from the City field locate the service disconnect pedestal, the Contractor shall contact the Construction Inspector (City of Omaha) at 402-444-5148 a minimum of two (2) weeks prior to installing the service disconnect pedestal. The service disconnect pedestal shall be installed and connected to the power source as soon as possible after construction of the signal begins.

Note: This is a one-hundred (100) AMP Service Rated Pedestal. Service conductors must be sized in accordance with National Electrical Code Section 230, Services.

Locate the service disconnect switch box within the line of sight of the controller cabinet and within one-hundred (100) feet or less of the controller cabinet unless otherwise indicated the Contract Documents or as directed by the Engineer.

Dig or bore holes at the location(s) and depth indicated in the Contract Documents for the construction of the pedestal foundation. The foundation shall be round or square. The excavation shall be dry and free of any loose materials before placing PCC. Level and secure all forms before commencing PCC placement.

The wiring shall be in accordance with NEMA IIB standards showing external connections and external equipment. All bussing shall be UL approved copper THHN cable bussing fully rated. Identify the function of all circuit breakers, switches, and other components using laminated engraved plastic nameplates with minimum one-fourth (¼) inch letters fastened with a minimum of two (2) No. 4-40 stainless steel machine screws.

C. Temporary Service Disconnect Switch Installation
When indicated in the Contract Documents, construct wood posts and mountings. Dig or bore holes at the location(s) and depth indicated in the Contract Documents for the construction of the wood pole foundation and anchors. Holes shall be round. Minimize the diameter of all holes. The installed post shall support the temporary disconnect in the proper position and to resist swaying or displacement.
Attach the service disconnect switch enclosure to one of the following:

1. The wood pole supporting the controller cabinet.
2. A wood power pole near the controller cabinet.
3. A wood sign post having a minimum dimension of four (4) inches by four (4) inches. Do not use this post for supporting any signs.

Locate the service disconnect switch box within the line of sight of the controller cabinet and within one-hundred (100) feet or less of the controller cabinet unless otherwise indicated in the Contract Documents or as directed by the Engineer.

907.04 Acceptance

The Engineer shall observe the work to check for compliance with the Contract Documents. Concrete foundations shall be constructed to the minimum compressive strength requirements identified in the Contract Documents. The Engineer shall verify the compressive strength of the concrete in accordance with the City of Omaha Materials and Testing Manual for Public Works Construction.

907.05 Measurement and Payment

The Engineer shall measure service disconnect pedestals for payment by each service disconnect pedestal supplied, constructed, and accepted.

The Engineer shall measure service disconnect pedestals with transfer switches for payment by each service disconnect pedestal with transfer switch supplied, constructed, and accepted.

The Engineer shall measure service disconnect switches for payment by each service disconnect switch supplied, constructed, and accepted.

The following items are considered subsidiary to items for which the Contract provides direct payment: service disconnect design, licenses, or associated permits; tree or shrub trimming; loading, hauling, construction of all materials, mounting hardware, grounding rod(s), and miscellaneous hardware; installing wire and/or conduit into an existing base/foundation/pad; compliance testing; and restoration of the surrounding area.

Payment shall be made under the following unless otherwise indicated in the Contract Documents. The Contract Price shall be full compensation for furnishing all labor, materials, equipment, tools, transportation, permits, licenses, and all incidentals necessary to complete the work.

When materials are furnished by the City, delivery of the specific items furnished shall be accepted at the location(s) identified in the Contract Documents. The Engineer shall measure each item furnished by the City for payment of each item installed and accepted.

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Install Service Disconnect Pedestal</td>
<td>Each</td>
</tr>
<tr>
<td>Install Service Disconnect Pedestal with Transfer Switch</td>
<td>Each</td>
</tr>
<tr>
<td>Install Service Disconnect Switch</td>
<td>Each</td>
</tr>
</tbody>
</table>
908 Vehicle Detectors

908.01 General
   A. Description
      This work includes furnishing and installing non-video vehicle detection systems, and all other
      miscellaneous items necessary to provide an operable system as indicated in the Contract
      Documents.
   B. Submittal Requirements
      Refer to Section 900.01 B for submittal requirements.

908.02 Material Requirements
   A. General
      Refer to Section 900.02 for general material requirements, in addition to the following
      requirements.
   B. Vehicle Detector Amplifiers – Model 222
      Vehicle detector amplifiers Model 222 shall be compatible with the Type 170 Traffic Control
      System and shall be in accordance with the latest version of the Traffic Signal Equipment
      Specifications published by the State of California Business, Transportation, and Housing
      Agency.
   C. Loop Detector Wire
      Loop detector wire shall be No. 14 AWG Type XHHW, cross-linked polyethylene insulated in
      accordance with IMSA 51-3.
   D. Detector Lead-in Cable
      Detector lead-in cable shall be No. 14 AWG stranded, pre-twisted, shielded, waterproof cable
      in accordance with IMSA Specification 50-2, Polyethylene Insulated, Polyethylene Jacketed,
      Loop Detector Lead-in Cable. Four (4) conductor lead-in cable for magnetometers shall be
      waterproof instrumentation cable complying with the magnetometer manufacturer’s
      recommendations.
   E. Sealant
      Loop detector sealant shall be Minnesota Mining and Manufacturing Company (3M) Loop
      Detector Sealant 5000 or equivalent.

908.03 Construction Requirements
   A. General
      Refer to Section 900.03 for general construction requirements, in addition to the following
      requirements.
   B. Loop Detector Installation
      Install vehicle detector loops at the locations indicated in the Contract Documents and in
      accordance with the manufacturer’s recommendations. If the existing pavement is in such
      condition that proper operation cannot be guaranteed for a period of two (2) years, install the
      loop as directed by the Engineer.
Install loops in existing pavement by saw cutting a one-fourth (¼) inch slot in the pavement along the path of the loop. Remove all loose material from the slot using an air compressor. Drill a hole to route the wiring through the curb and gutter to the outside edge of the pavement. Insert the loops into the sawed slot without damaging the wires. Tamp the wire into the slot using a blunt tool. Do not use sharp instruments such as screwdrivers, etc. Exercise caution around corners and sharp bends to avoid damaging the insulation or introducing undue stresses on the wire. Route detector loop wiring through a one-half (½) inch non-metallic flexible tubing at locations where the wiring crosses a roadway expansion joint or crack. Do not route more than three (3) detector loop wires in the same slot. Seal saw cuts and holes from installation of vehicle detectors. Install loops the same day as constructing the saw cuts. Do not open an area to traffic after beginning saw cutting until completion of the loop installation.

Install a one-half (½) inch diameter schedule 40 polyvinyl chloride (PVC) conduit for each loop detector from the hole in the curb to the pull box or signal base. Install a three-fourth (¾) inch diameter schedule 40 PVC conduit whenever routing multiple loops through the same hole in the pavement. Do not install more than three (3) loop detector wires in a three-fourth (¾) inch diameter conduit. Splice the loop wire to the loop lead-in cable at a pull box or pole base. Do not install any splices outside of a pull box or pole base.

Install all loops in new pavement by casting them integrally with the new pavement. Securely stake the loops on the surface of the underlying subgrade or base course. Use care to prevent damage to the loop during the paving operation. For installations in PCC pavement, position loops before commencing PCC placement. Coat the detector loops with a bond breaking membrane that prevents the PCC from adhering to the conduit. Saw cutting loops into the surface of any new PCC pavement is not allowed.

For installations in conjunction with ACP overlays or surfacing less than two (2) inches in depth, the Contractor may saw cut a slot into the underlying existing pavement surface and position the loops twenty-four (24) hours before placing the surfacing. Cover the wires with a minimum of one-half (½) inch thick ACP placed by hand and lightly compacted before constructing the surface lift. Obtain written permission from the Engineer before installing loops in this manner.

908.04 Acceptance

The Engineer shall observe the work to check for compliance with the Contract Documents.

908.05 Measurement and Payment

The Engineer shall measure vehicle loop detectors for payment by the type of each vehicle loop detector supplied, constructed, and accepted.

The Engineer shall measure vehicle loop detector repairs for payment by each vehicle loop detector repaired and accepted.

The Engineer shall measure two (2) channel loop detector amplifiers for payment by each two (2) channel loop detector amplifier supplied, constructed, and accepted.

The following items are considered subsidiary to items for which the Contract provides direct payment: vehicle detector design, licenses, or associated permits; tree or shrub trimming; loading, hauling, construction of all materials, mounting hardware, grounding rod(s), and miscellaneous hardware; installing wire and/or conduit into an existing base/foundation/pad; and restoration of the surrounding area.
Payment shall be made under the following unless otherwise indicated in the Contract Documents. The Contract Price shall be full compensation for furnishing all labor, materials, equipment, tools, transportation, permits, licenses, and all incidentals necessary to complete the work.

When materials are furnished by the City, delivery of the specific items furnished shall be accepted at the location(s) identified in the Contract Documents. The Engineer shall measure each item furnished by the City for payment of each item installed and accepted.

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Install Vehicle Detector, Type TD-___, <em><strong>'x'</strong></em> with ___ Turns Of Wire</td>
<td>Each</td>
</tr>
<tr>
<td>Repair Loop Detector</td>
<td>Each</td>
</tr>
<tr>
<td>Install Two (2) Channel Loop Detector Amplifier</td>
<td>Each</td>
</tr>
</tbody>
</table>
909 Radar Vehicle Detection System

909.01 General

A. Description

This work includes furnishing and installing radar vehicle detection systems, and all other miscellaneous items necessary to provide an operable system as indicated in the Contract Documents, tested, and in operating condition.

B. Submittal Requirements

Refer to Section 900.01 B for submittal requirements.

909.02 Material Requirements

A. General

Refer to Section 900.02 for general material requirements, in addition to the following requirements.

B. Radar Vehicle Detection System

The radar vehicle detection system shall currently be in production. The system shall have a minimum of six (6) months of successful operation at a similar location at the time of the bid opening. Submit a list of users complete with agency name, address, telephone number, and contact person included with the bid. Failure to submit this information may result in the rejection of the proposal.

The radar detection system shall provide flexible detection zone placement anywhere and at any orientation within the combined field or view of the image sensors. Preferred presence detector configurations shall be determined by the manufacturer.

Performance of the radar detection system shall be comparable to inductive loop vehicle detectors. The radar detection system shall reliably detect vehicle presence when the sensor is mounted in accordance with the manufacturer’s recommendations.

C. Miscellaneous Hardware

Supply all necessary cables, brackets, and hardware in accordance with the manufacturer’s recommendations.

D. Warranty, Maintenance, and Support

Provide all product documentation. Product documentation must be written in the English language. The supplier shall provide a minimum two (2) year warranty on the radar detection system beginning on the date of acceptance and approval for payment by the City. During this two (2) year period, the supplier shall provide the City continuous hardware and software support including any updates of the system hardware or system software at no additional cost. The supplier shall provide technical support, via telephone, within four (4) hours of a request by the City. Factory-certified personnel or installers shall provide such support. The supplier may negotiate a separate agreement with the City for continued technical support and upgrades following the expiration of the warranty period.

The supplier shall maintain a program for technical support updates following expiration of the warranty period. Coordinate this program with the City of Omaha in the form of a separate agreement for continuing support.
909.03 Construction Requirements

A. General
   Refer to Section 900.03 for general construction requirements, in addition to the following requirements.
   
   Notify the Engineer one (1) week before changing any approach lanes using video detection during construction to allow for reprogramming of the video detection system.

B. System Installation
   Before the radar sensors are installed, a certified representative from the supplier shall review the Contract Documents and determine if the placement(s) of the radar sensors are suitable. If the placement of any sensor is determined to be not suitable, the supplier’s representative shall recommend suitable placement of the sensor. Re-install any sensor placed without the supplier review that are not effective due to the placement at no additional cost to the City. A certified representative from the supplier shall supervise installation and testing of the system. Install the system in accordance with the manufacturer’s recommendations.

C. System Training
   Provide installation and training support using certified representatives from the supplier.

909.04 Acceptance
   The Engineer shall observe the work to check for compliance with the Contract Documents.

909.05 Measurement and Payment
   The Engineer shall measure modular video vehicle detection systems for payment by each modular video vehicle detection system supplied, installed, and accepted.

   The following items are considered subsidiary to items for which the Contract provides direct payment: traffic control device design, licenses, or associated permits; tree or shrub trimming; loading, hauling, construction of all materials, mounting hardware, grounding rod(s), and miscellaneous hardware; installing wire and/or conduit into an existing base/foundation/pad; and restoration of the surrounding area.

   The following items are considered subsidiary to items for which the Contract provides direct payment: radar vehicle detection system design, licenses, or associated permits; tree or shrub trimming; loading, hauling, construction of all materials, mounting hardware, grounding rod(s), and miscellaneous hardware; installing wire and/or conduit into an existing base/foundation/pad; supplier review; and restoration of the surrounding area.

   Payment shall be made under the following unless otherwise indicated in the Contract Documents. This Contract Price shall be full compensation for furnishing all labor, materials, equipment, tools, transportation, permits, licenses, and all incidentals necessary to complete the work.

   When materials are furnished by the City, delivery of the specific items furnished shall be accepted at the location(s) identified in the Contract Documents. The Engineer shall measure each item furnished by the City for payment of each item installed and accepted.

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Furnish and Install Radar Vehicle Detection System - Approach</td>
<td>Each</td>
</tr>
<tr>
<td>Install Radar Vehicle Detection System - Approach</td>
<td>Each</td>
</tr>
</tbody>
</table>
910 Preemption Control System

910.01 General

A. Description
This work includes furnishing and installing preemption control systems, and all other miscellaneous items necessary to provide an operable system as indicated in the Contract Documents.

B. Submittal Requirements
Refer to Section 900.01 B for submittal requirements.

910.02 Material Requirements

A. General
Refer to Section 900.02 for general material requirements, in addition to the following requirements.

B. Preemption Control System
Preemption control systems shall be the Opticom Priority Control System developed by the 3M Company. No alternatives will be accepted.

C. Detector Cable
Detector cable shall be 3M Detector Cable, Model Number 138.

910.03 Construction Requirements

A. General
Refer to Section 900.03 for general construction requirements, in addition to the following requirements.

Notify the Engineer one (1) week before changing any approach lanes using video detection during construction to allow for reprogramming of the video detection system.

B. System Installation
Install the system in accordance with the manufacturer’s recommendations. Install the detector cable from the Optical Detector on the mast arm to the Phase Selector inside the controller cabinet. Install the wire inside the mast arm and upright and through the underground conduit to the Phase Selector/Controller Cabinet. Do not splice the detector cable.

910.04 Acceptance
The Engineer shall observe the work to check for compliance with the Contract Documents.

910.05 Measurement and Payment
The Engineer shall measure preemption control systems for payment by each preemption control system supplied, installed, and accepted.

The following items are considered subsidiary to items for which the Contract provides direct payment: preemption control system design, licenses, or associated permits; tree or shrub trimming; loading, hauling, construction of all materials, mounting hardware, grounding rod(s), and miscellaneous hardware; installing wire and/or conduit into an existing base/foundation/pad; training; and restoration of the surrounding area.
Payment shall be made under the following unless otherwise indicated in the Contract Documents. The Contract Price shall be full compensation for furnishing all labor, materials, equipment, tools, transportation, permits, licenses, and all incidentals necessary to complete the work.

When materials are furnished by the City, delivery of the specific items furnished shall be accepted at the location(s) identified in the Contract Documents. The Engineer shall measure each item furnished by the City for payment of each item installed and accepted.

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Install Preemption Control System</td>
<td>Each</td>
</tr>
</tbody>
</table>
911 Traffic Calming Devices

911.01 General

A. Description
This work includes construction of Portland Cement Concrete (PCC) traffic calming devices and pavement on prepared subgrade, base, or sub-base materials in accordance with the specifications, lines, grades, and cross sections indicated in the Contract Documents or as directed by the Engineer.

B. Submittal Requirements
Refer to Section 900.01 B for submittal requirements.

911.02 Material Requirements

A. General
Refer to Section 900.02 for general material requirements, in addition to the following requirements.

B. Rigid Pavement
Refer to Section 500 for rigid pavement material requirements.

C. Pavement Markings
Refer to Section 905 for pavement markings material requirements.

911.03 Construction Requirements

A. General
Refer to Section 900.03 for general construction requirements, in addition to the following requirements

Rigid pavement shall be constructed in accordance with Section 500.

Pavement markings shall be constructed in accordance with Section 905.03.

B. Traffic Calming Devices
Traffic calming devices shall be constructed in accordance with Standard Plate 911-01. The Contractor shall schedule construction of traffic calming devices with the City of Omaha Traffic Engineer’s Office.

Traffic calming devices may be constructed under traffic conditions. The Contractor shall close only half of the street at a time to keep the street open. The Traffic Engineer shall approve any closure of a street before work is started. The City of Omaha Barricade Manual shall be used for placing and maintaining barricades in the street.

911.04 Acceptance
The Engineer shall observe the work to check for compliance with the Contract Documents. Rigid pavement shall be accepted in accordance with Section 500 for compressive strength, smoothness, and cracks. Perform corrective action or removal and replacement activities at no additional cost to the City. Backfill shall be constructed to the minimum compaction requirements identified in the Contract Documents. The Engineer shall verify the compaction of the backfill in accordance with the City of Omaha Materials and Testing Manual for Public Works Construction.
The Contractor shall perform a survey of the constructed traffic calming device to verify the dimensions of the device. The survey information shall be submitted in a format and contain required information as directed by the Engineer. The average height deviation shall be calculated by the Engineer based on the survey information provided by the Contractor.

911.05 Measurement and Payment

The Engineer may assess pay deductions for failure to meet the acceptance requirements in accordance with Table 911.01.

The pay factor for average height deviation determination applies to the entire quantity of each traffic calming device constructed. Pay factors shall be deducted from final payment.

<table>
<thead>
<tr>
<th>Larger Average Height Deviation (Inches)</th>
<th>Pay Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intermediate Cross Line</td>
<td>Top Cross Line</td>
</tr>
<tr>
<td>Less than 0.375</td>
<td>Less than 0.25</td>
</tr>
<tr>
<td></td>
<td>0.25 to 0.49</td>
</tr>
<tr>
<td></td>
<td>0.50 and Over</td>
</tr>
<tr>
<td>0.375 to 0.49</td>
<td>Less than 0.25</td>
</tr>
<tr>
<td></td>
<td>0.25 to 0.49</td>
</tr>
<tr>
<td></td>
<td>0.50 and Over</td>
</tr>
<tr>
<td>0.50 and over</td>
<td>Any Deviation</td>
</tr>
</tbody>
</table>

The Engineer shall measure traffic calming devices for payment by the square yards of pavement constructed, backfilled, and accepted.

The following items are considered subsidiary to items for which the Contract provides direct payment: traffic control coordination, barricading, utility locations, forming, and providing curing of the rigid pavement. Additional payment for pavement removed outside of the traffic calming device will be measured and paid in accordance with Section 500.

Payment shall be made under the following unless otherwise indicated in the Contract Documents. The Contract Price shall be full compensation for furnishing all labor, materials, equipment, tools, transportation, permits, licenses, and all incidentals necessary to complete the work.

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construct Traffic Calming Device</td>
<td>Square Yard</td>
</tr>
</tbody>
</table>
SECTION 1000 – MAINTENANCE AND REPAIR

1000 Maintenance and Repair

1000.01 General

A. Description
The information, submittal and material requirements, and construction requirements of this section shall apply to all subsections within Section 1000 unless otherwise specified. This section includes crack and joint repair, maintenance and repair of pavement, and sewer repair.

B. Submittal Requirements
The Contractor shall submit, in accordance with the General Conditions, the following submittals:
1. Material specifications and installation procedures for joint sealant.
3. Rigid pavement submittals shall be in accordance with Section 500.
4. Flexible pavement submittals shall be in accordance with Section 400.
5. Sewer and subsurface submittals shall be in accordance with Section 700.
6. Manhole shrink wrap material certifications and manufacturer’s installation recommendations.

1000.02 Material Requirements

A. Joint Sealant
Joint sealant shall be in accordance with Section 500.

B. Crack Repair Fabric
Crack repair fabric shall be a minimum of twelve (12) inches wide and shall be in accordance with AASHTO M288, Geotextile Specification for Highway Applications, Section 9. Store crack repair fabric in a cool, dry location free from dust.

C. Rigid Pavement
Rigid pavement shall be in accordance with Section 500.

D. Calcium Chloride
Calcium chloride shall be in accordance with ASTM D98, Specifications for Calcium Chloride. The maximum amount of calcium chloride added shall not exceed two (2) percent by weight of the total amount of cement in the mixture. Calcium chloride shall only be evaluated for use in situations when both emergency considerations and cold weather are present and shall only be used when directed by the Engineer. Add calcium chloride in accordance with the manufacturer’s recommendations. Mix the calcium chloride solution with the concrete for a minimum of thirty (30) revolutions before commencing placement of the PCC.

E. PCC Additives
Do not use other types of additives in PCC without prior written approval by the Engineer.
F. Flexible Pavement  
Flexible pavement shall be in accordance with Section 400.

G. Sewers, Inlets, and Manholes  
Sewers, inlets, and manholes shall be in accordance with Section 700.

H. Manhole Shrink Wrap  
Manhole shrink wrap material shall be heat-shrinkable sleeves coated with protective heat-activated adhesive and be capable of bonding to primed concrete, metal and fiberglass surfaces.

1000.03 Construction Requirements

A. General  
1. The Contractor shall schedule work such that continuous access to each property is maintained. The Contractor shall notify, in writing, any property owner that will have their access restricted a minimum of forty-eight (48) hours before commencing the work.

2. Any damage that is caused to adjacent pavement shall be removed and replaced at no additional cost to the City.

B. Removals  
Removal of existing pavement shall be performed in accordance with Section 100, except as modified herein. Removal limits shall be in accordance with Standard Plate 1002-02, or as directed by the Engineer. Full depth saw-cutting shall be required around the perimeter of the removal limits of existing pavement.

Unforeseen obstructions encountered during removals shall be removed in their entirety, or as directed by the Engineer. When removing streetcar or railroad rails, the ties shall be removed in their entirety or as directed by the Engineer. Removed streetcar or railroad rails shall be delivered to the City as directed by the Engineer.

1. Rigid Pavement Removal  
Existing rigid pavement shall be removed to surrounding sound pavement and shall be saw cut around the perimeter of the repair area in accordance with Section 100, or as directed by the Engineer. The sides of the repair area shall be trued to a vertical face.

2. Asphalt Surface Pavement Removal  
Existing asphalt surface pavement shall be removed to surrounding sound pavement and shall be saw cut around the perimeter of the repair area in accordance with Section 100, or as directed by the Engineer. At a minimum, the length of the asphalt surface pavement removal shall be the entire length of excavation plus an additional six (6) inches on each end. The sides of the repair area shall be trued to a vertical face.

C. Forms  
Forms comprised of wood or metal shall be used for pavement lengths less than thirty (30) feet. For pavement lengths greater than thirty (30) feet, metal forms shall be used.

D. Adjusting Manholes and Utility Valves  
Manholes adjusted for pavement repair shall be adjusted in accordance with Standard Plate 1002-02 and Section 700. Manholes adjusted for resurfacing shall be adjusted in accordance with Standard Plate 1002-02 and Section 700. Remove and reconstruct pavement in accordance with Section 1000.03. Any deteriorated riser sections shall be removed and replaced. For
maintenance and repair projects only, when directed by the Engineer, the Contractor shall deliver existing broken or unserviceable manhole rings and covers to the City Sewer Maintenance Yard and pick up replacements. Set all rings and covers to the elevation indicated in the Contract Documents or as directed by the Engineer. Use precast concrete riser sections and shims to adjust the manhole castings to grade. The height of final adjustment using shims shall be no more than two (2) inches. All voids shall be filled and consolidated with grout to the full depth of the riser sections. Shims shall be removed as the grout is installed. External frame seals shall be installed on all adjusted manholes in accordance with Section 700, unless installation is prohibited by the existing structure. Frame seals shall be re-used when removal and salvage of an existing frame seal is possible. The Engineer may allow installation of twelve (12) inch wide shrink wrap in lieu of frame seals. The Contractor shall remove all foreign debris and concrete spillage from the manhole prior to final acceptance.

The Engineer may allow installation of twelve (12) inch wide shrink wrap in lieu of frame seals on existing manholes. Manhole shrink wrap shall be installed in accordance with the manufacturer’s recommendations. The manhole shrink wrap shall be allowed to cool before backfilling operations commence. Cooling methods shall be in accordance with the manufacturer’s recommendations.

Utility valves shall be adjusted in accordance with Section 500.

E. Subgrade Preparation

Subgrade shall be prepared in accordance with Section 200, except as modified herein. When directed by the Engineer, unsuitable subgrade material shall be removed, replaced, and compacted with three-fourth (¾) inch rock or recycled concrete. Gradation of the rock or recycled concrete shall be in accordance with Table 1000.01.

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Target Value</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 ½ Inch</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>¾ Inch</td>
<td>80</td>
<td>±10</td>
</tr>
<tr>
<td>#8</td>
<td>25</td>
<td>±15</td>
</tr>
<tr>
<td>#200</td>
<td>6.5</td>
<td>±3.5</td>
</tr>
</tbody>
</table>

For permanent pavement, all frozen subgrade material shall be removed to a minimum of two (2) inches below the observed frost depth, replaced, and compacted with three-fourth (¾) inch rock or recycled concrete. Subgrade shall be further prepared in accordance with Section 200.

For temporary pavement, all frozen subgrade material shall be removed to a minimum of two (2) inches below the observed frost depth, replaced, and compacted with three-fourth (¾) inch rock or recycled concrete. Subgrade shall be further prepared in accordance with Section 200.

F. Pavement Repair

Pavement repair shall be constructed in accordance with Standard Plate 1002-02. Pavement repairs shall be full-depth rigid pavement for all repairs unless otherwise indicated in the Contract Documents.

Small area pavement repair shall consist of individual sections of pavement having an area less than sixty (60) square yards.
Large area pavement repair shall consist of individual sections of pavement which do not conform to the definition of small areas.

The Engineer shall determine if temporary or permanent pavement will be constructed. If cold weather, as defined in Section 500.03 H.3, inhibits construction of the pavement, then the pavement will be considered temporary and shall be permanently constructed as weather and subgrade conditions allow. Permanent pavement shall be constructed and protected in accordance with Standard Plate 1002-02 and Section 500, except as modified herein. Unless otherwise directed by the Engineer, temporary pavement shall consist of a minimum of six (6) inches of Type L6 PCC and shall be constructed in accordance with Section 500.

The required thickness of permanent rigid pavement shall be in accordance with Standard Plate 1002-02, or as directed by the Engineer. When indicated in the Contract Documents or as directed by the Engineer, surcharges associated with providing PCC during cold weather shall be measured and paid for separately from construction of the pavement repairs.

All joints shall be sawed and sealed after completion of paving, including construction joints. Joints shall match the existing joint pattern of surrounding pavement and be in accordance with Standard Plate 501-01.

New control joints shall be constructed in surrounding existing pavement when removal and replacement of only a portion of a particular panel is required by the Engineer. Existing panels adjacent to the removal area shall have control joints sawed to prevent mirror cracking of the new maintenance area joint through the existing panel(s). This new control joint shall be constructed as to form a continuous control joint from curb to curb.

G. Pavement Markings

The pavement markings obscured and/or damaged as a result of performing the repairs shall be remarked in accordance with Section 900. The new markings shall be the same type as the existing markings unless otherwise directed by the Engineer. Markings shall be remarked before pavement is reopened unless otherwise directed by the Engineer.

H. Surrounding Area

The disturbed areas surrounding the repairs shall be restored with topsoil and seeded in accordance with Section 800.
1001 Crack or Joint Repair

1001.01 General
   A. Description
       This work includes the routing, cleaning, and repair of random cracks or pavement joints in existing pavement.
   B. Submittal Requirements
       Refer to Section 1000.01 B for submittal requirements.

1001.02 Material Requirements
   A. General
       Refer to Section 1000.02 for general material requirements. Additional material requirements shall be in accordance with Section 400 and Section 500.

1001.03 Construction Requirements
   A. General
       Refer to Section 1000.03 for general construction requirements, in addition to the following requirements.
   B. Crack or Joint Repair – Type “A”
       Type “A” crack or joint repair shall be applicable to both rigid and flexible pavements. Remove all existing crack filler, sealer, debris, and vegetation from the designated joints or cracks. Accomplish the removal using a scraping device, router, air compressor, or other similar equipment as necessary to produce a surface to which sealant can adhere within the crack or joint. All material removed from cracks and joints shall be removed and disposed of in accordance with Section 100, and the site shall be restored to original existing conditions or better. Rout all joints or cracks narrower than one-half (½) inch wide to a minimum width of one-half (½) inch. The minimum depth of a routed joint or crack shall be three-fourth (¾) inch below the pavement surface. Remove all loose or spalled material from cracks or joints wider than one-half (½) inch to a minimum depth of one (1) inch. Apply the sealant to the prepared crack or joint in accordance with the manufacturer’s recommendations. Apply the sealant to within one-eighth (⅛) inch below the existing pavement surface.
   C. Crack or Joint Repair – Type “B”
       Type “B” crack or joint repair shall be applicable to flexible pavements. Mill the designated crack or joint in accordance with Section 100, except as modified herein, to a minimum depth of two (2) inches and a maximum depth of four (4) inches. The width of the milling shall be a minimum of twelve (12) inches and a maximum of eighteen (18) inches centered on the crack or joint. All material removed from cracks and joints shall be removed and disposed of in accordance with Section 100, and the site shall be restored to original existing conditions or better. Remove all loose particles from the milled crack or joint and apply a bituminous tack coat to the bottom and sides of the milled surface in accordance with Section 400. Place crack repair fabric along the crack or joint in the milled surface as indicated in the Contract Documents or as directed by the Engineer. Install the crack repair fabric in accordance with the manufacturer’s recommendations. Fill the milled area with flexible pavement in one (1) or more lifts in accordance with Section 400.
1001.04 Acceptance

The Engineer shall observe the work to check for compliance with the Contract Documents.

1001.05 Measurement and Payment

The Engineer shall measure crack or joint repairs for payment by the linear feet of the type of crack or joint repaired and accepted.

Payment shall be made under the following unless otherwise indicated in the Contract Documents. The Contract Price shall be full compensation for furnishing all labor, materials, equipment, tools, and all incidentals necessary to complete the work.

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crack or Joint Repair – Type &quot;A&quot;</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Crack or Joint Repair – Type &quot;B&quot;</td>
<td>Linear Foot</td>
</tr>
</tbody>
</table>
1002 Pavement Repair

1002.01 General
   A. Description
      This work includes removal and replacement of rigid pavement, asphalt surface pavement, sidewalk, driveways, multi-use trail, curb, combination curb and gutter, and other related appurtenances. Removal of existing materials shall be in accordance with Section 100. Replacement or reconstruction of the removed materials shall be in accordance with Section 500, except as modified herein. Pavement repairs shall also be in accordance with Standard Plates 1002-01 and 1002-02.

   B. Submittal Requirements
      Refer to Section 1000.01 B for submittal requirements. Refer to Section 500 for additional submittal requirements.

1002.02 Material Requirements
   A. General
      Refer to Section 1000.02 for general material requirements. Additional material requirements shall be in accordance with Section 100 and Section 500.

1002.03 Construction Requirements
   A. General
      Refer to Section 1000.03 for general construction requirements, in addition to the following requirements.

   B. Protection of Prepared Subgrade
      The Contractor shall be responsible for protecting subgrade material during cold weather. When directed by the Engineer, protection of prepared and accepted subgrade shall be a separate work item associated with pavement repair only. After placing rigid pavement, the Contractor shall be responsible for protecting the pavement from cold weather in accordance with Section 500. Protection of subgrade material includes, but is not limited to, providing, installing and removing insulated blankets, plastic sheeting, burlap, ground-thaw systems, or other methods of keeping prepared subgrades at required temperatures for concrete placement. This work is applicable to maintenance, emergency street repairs, and utility cut projects only.

   C. Protection of Cold Weather Rigid Pavement
      The Contractor shall be responsible for protecting rigid pavement during cold weather. When indicated in the Contract Documents or as directed by the Engineer, protection of constructed and accepted rigid pavement shall be a separate work item associated with rigid pavement repair only. After placing rigid pavement, the Contractor shall be responsible for protecting the pavement from cold weather in accordance with Section 500. Protection of cold weather rigid pavement includes, but is not limited to, providing, installing, and removing insulated blankets, plastic sheeting, burlap, ground-thaw systems, or other methods of keeping constructed pavements at required temperatures for curing. This work is applicable to maintenance, emergency street repairs, and utility cut projects only.
D. **Curb and Gutter**

Curb and gutter wider than two (2) feet shall be considered pavement repair. Existing pavement panels with integral curb and gutter shall be entirely removed and replaced by pavement panels with integral curb and gutter. Existing pavement with separate curb and gutter shall be removed and replaced in accordance with the Contract Documents or as directed by the Engineer. New curb and gutter shall be constructed in accordance with Section 500 and the Standard Plates.

E. **Inlet Throats**

Inlet throats shall be removed to the nearest joint(s). If existing pavement at the throat is part of a larger panel of pavement, the entire panel shall be removed and replaced. New inlet throats and pavement shall be constructed in accordance with Section 1000.03 and the Standard Plates. The Contractor shall use a gutter depression template to construct inlet openings in accordance with the Standard Plates.

F. **Driveways, Sidewalks, Median Surfacing, Mow Strips, and Multi-Use Trails**

Driveways, sidewalks, median surfacing, mow strips, and multi-use trails shall be removed to the nearest joint(s). New driveways, sidewalks, median surfacing, mow strips, and multi-use trails shall be constructed in accordance with Section 500 and the Standard Plates. Small areas of sidewalk shall be a contiguous area of sidewalk repairs less than or equal to seventy-five (75) square feet. Large areas of sidewalk shall be a contiguous area of sidewalk repairs greater than seventy-five (75) square feet.

G. **Curb Ramps**

Curb ramps shall be removed to the nearest joint(s). New curb ramps shall be constructed in accordance with Section 500 and the Standard Plates. New curbs and gutters constructed in conjunction with curb ramps shall have tie-bars installed in accordance with the Standard Plates.

1002.04 **Acceptance**

The Engineer shall observe the work to check for compliance with the Contract Documents. Acceptance requirements shall be in accordance with Section 500. Pavement repairs shall be constructed to the minimum compressive strength requirements identified in the Contract Documents. The Engineer shall verify the compressive strength of the concrete in accordance with the City of Omaha Materials and Testing Manual for Public Works Construction. Unless otherwise directed by the Engineer, pavement repairs not meeting the acceptance requirement(s) shall be removed and replaced at no additional cost to the City.

1002.05 **Measurement and Payment**

The Engineer shall measure pavement repairs for payment by the square yards of the type of pavement removed, constructed, and accepted.

The Engineer shall measure curb and gutter repairs for payment by the linear feet of curb and gutter removed, constructed, and accepted.

The Engineer shall measure driveway repairs for payment by the square yards of driveway removed, constructed, and accepted.

The Engineer shall measure sidewalk repairs for payment by the square feet of the thickness of sidewalk removed, constructed, and accepted.
The Engineer shall measure median surfacing repairs for payment by the square feet of median surfacing removed, constructed, and accepted.

The Engineer shall measure mow strip repairs for payment by the square feet of mow strip removed, constructed, and accepted.

The Engineer shall measure multi-use trail repairs for payment by the square feet of multi-use trail removed, constructed, and accepted.

The Engineer shall measure curb ramp repairs for payment by the square feet of curb ramp removed, constructed, and accepted.

The Engineer shall measure protection of prepared subgrade for payment by the square yards of subgrade prepared, protected, and accepted.

The Engineer shall measure protection of cold weather rigid pavement for payment by the square yards of cold weather rigid pavement constructed, protected, and accepted.

The Engineer shall measure temporary pavement repairs for payment by the square yards of temporary pavement constructed and accepted.

The Engineer shall measure adjusting inlets to grade for payment by each inlet adjusted and accepted.

Payment shall be made under the following unless otherwise indicated in the Contract Documents. The Contract Price shall be full compensation for furnishing all labor, materials, equipment, tools, and all incidentals necessary to complete the work.

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Repair Pavement – Large Area (Type ___)</td>
<td>Square Yard</td>
</tr>
<tr>
<td>Repair Pavement – Small Area (Type ___)</td>
<td>Square Yard</td>
</tr>
<tr>
<td>Repair Curb and Gutter</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Repair Driveway</td>
<td>Square Yard</td>
</tr>
<tr>
<td>Repair ___” Sidewalk – Large Area</td>
<td>Square Foot</td>
</tr>
<tr>
<td>Repair ___” Sidewalk – Small Area</td>
<td>Square Foot</td>
</tr>
<tr>
<td>Repair Median Surfacing</td>
<td>Square Foot</td>
</tr>
<tr>
<td>Repair Mow Strip</td>
<td>Square Foot</td>
</tr>
<tr>
<td>Repair Multi-Use Trail</td>
<td>Square Foot</td>
</tr>
<tr>
<td>Repair Curb Ramp</td>
<td>Square Foot</td>
</tr>
<tr>
<td>Protection of Prepared Subgrade</td>
<td>Square Yard</td>
</tr>
<tr>
<td>Cold Weather Rigid Pavement Protection</td>
<td>Square Yard</td>
</tr>
<tr>
<td>Construct Temporary Pavement Repair</td>
<td>Square Yard</td>
</tr>
<tr>
<td>Adjust Inlet to Grade</td>
<td>Each</td>
</tr>
</tbody>
</table>
1003 Brick Pavement Repair

1003.01 General

A. Description
This work includes removal and replacement of brick pavement. Removal of existing materials shall be in accordance with Section 100. Brick pavement repairs shall be in accordance with Standard Plate 1003-01.

B. Submittal Requirements
Refer to Section 1000.01 B for submittal requirements.

1003.02 Material Requirements

A. General
Refer to Section 1000.02 for general material requirements. Additional material requirements shall be in accordance with Section 100 and Section 500.

B. Cushion Sand
Cushion sand shall conform to the requirements for fine aggregate in accordance with ASTM C33, Standard Specification for Concrete Aggregates, including gradation requirements.

C. Joint Sand
Joint sand shall be in accordance with ASTM C144, Standard Specification for Aggregate for Masonry Mortar, including gradation requirements.

1003.03 Construction Requirements

A. General
Refer to Section 1000.03 for general construction requirements, in addition to the following requirements.

B. Brick Pavement Repair
Existing brick pavement shall be removed to surrounding sound pavement in accordance with Section 100 or as directed by the Engineer. The Contractor shall salvage, protect, and return to the City the brick and/or cobblestones removed during the course of the work. Brick pavement repair shall be constructed in accordance with Standard Plate 1003-01. The subgrade shall be prepared in accordance with Section 1003.03 C. Concrete base shall be seven (7) inches thick and be constructed in accordance with Section 500.

Uniformly spread and compact the cushion sand to form a smooth, level layer having a thickness of two (2) inches after compaction. To verify that the cushion sand level is correct, place a full-width layer of bricks to the finished surface elevation and check after completion of the first five (5) feet and at frequent intervals thereafter.

Each brick shall be cleaned and free of all debris prior to its placement on the cushion sand. The cost of cleaning bricks shall be incidental to items for which direct payment is made. Place the bricks atop the compacted cushion sand in the pattern indicated in the Contract Documents or as directed by the Engineer. Place subsequent bricks firmly against the adjacent bricks to achieve a butt joint. Position the brick until it is in the correct position without disturbing the compacted cushion sand.
Close joints using a hide mallet or other methods that do not damage the brick. Do not tilt bricks on the leading edge of the laying face. Cut bricks to fit along pavement edges, manholes, valve boxes, and miscellaneous obstacles. Bricks shall be cut with either a block splitter or masonry saw. Broken bricks shall not be used. Do not place cut edges in interior areas of the brick pavement. Use mortar to fill gaps less than two (2) inches wide. Avoid disturbing the bricks before vibrating.

Continue brick placement until sufficient area is available for vibrating. Vibrate the bricks to the final elevation using a plate vibrator. Guide the plate vibrator over the area, avoiding any restrained edges. Correct uneven surfaces after vibrating. Brush dry joint sand over the surface of the pavement after the initial passes of the plate vibrator to fill minor gaps between bricks. Continue vibrating until completely compacted. Mist the pavement surface with water after compaction is complete. Brush dry joint sand over the pavement after the water mist has evaporated, and mist the pavement surface with water again. Remove excess joint sand after the water mist has evaporated.

If the final elevation of the brick pavement is incorrect, remove the bricks and reconstruct the cushion sand to the required level. Re-position the bricks to the correct grade, vibrate, fill the joints with joint sand, mist the surface after compaction, and remove excess sand when dry.

For streets with longitudinal slopes of five (5) percent or greater, polymeric jointing sand shall be used for brick pavement joints.

C. **Brick Pavement Subgrade Repair**

Unless otherwise indicated in the Contract Documents, brick pavement subgrade repair shall consist of over-excavating, hauling off, and disposing of excess material; providing, placing, and compacting aggregate base; or constructing concrete base in accordance with Standard Plate 1003-01 or as directed by the Engineer. Existing subgrade shall be over-excavated from thirteen (13) inches to eighteen (18) inches below the bottom of the proposed brick pavement cushion sand unless otherwise directed by the Engineer. After over-excavation, the resultant subgrade shall be compacted and prepared in accordance with Section 200.

For brick pavement subgrade replacement using aggregate, the aggregate base material shall be Type Aggregate Subbase/Base and constructed in accordance with Section 300. For brick pavement subgrade replacement using concrete, the concrete shall be Type L85 and constructed in accordance with Section 500. The finished surface of compacted aggregate shall not allow cushion sand to migrate into it. If the finish surface of compacted aggregate will allow migration of cushion sand, the Contractor shall construct a choke course of fine material or a bitumen tack coat at no additional cost to the City.

D. **Protection of Prepared Subgrade**

The Contractor shall be responsible for protecting subgrade material during cold weather. Protection of prepared and accepted subgrade shall be a separate work item. After placing concrete base, the Contractor shall be responsible for protecting the base from cold weather in accordance with Section 500.

E. **Brick Joint Restoration**

The Contractor shall restore sand joints between brick pavers in accordance with Section 1003.03 B and the following requirements. Sand shall be mechanically swept into joints then misted with water. After watering, an additional sweep with joint sand shall be applied, leaving
a thin layer one-quarter (0.25) inches thick of joint sand over the restoration area. Excess sand shall be removed from the site.

For streets with longitudinal slopes of five (5) percent or greater, polymeric jointing sand shall be used for brick pavement joints.

F. Concrete Delineation Strip

The Contractor shall construct a concrete delineation strip between existing pavement and brick pavement in accordance with Standard Plate 1000-01 at locations shown in the Contract Documents. Concrete shall be Type L85 and constructed in accordance with Section 500.

1003.04 Acceptance

The Engineer shall observe the work to check for compliance with the Contract Documents. Acceptance requirements shall be in accordance with Sections 200, 300, and 500. Pavement repairs shall be constructed to the minimum compressive strength requirements identified in the Contract Documents. The Engineer shall verify the compressive strength of the concrete in accordance with the City of Omaha Materials and Testing Manual for Public Works Construction. Unless otherwise directed by the Engineer, pavement repairs not meeting the acceptance requirement(s) shall be removed and replaced at no additional cost to the City.

1003.05 Measurement and Payment

The Engineer shall measure brick pavement repairs for payment by the square yards of brick pavement removed, salvaged, constructed, and accepted.

The Engineer shall measure brick pavement subgrade repairs using aggregate for payment by the square yards of excess subgrade over-excavated, hauled off, and disposed, subgrade prepared, and aggregate supplied, constructed, compacted, and accepted.

The Engineer shall measure brick pavement subgrade repairs using concrete for payment by the square yards of excess subgrade over-excavated, hauled off, and disposed, subgrade prepared, and concrete constructed and accepted.

The Engineer shall measure protection of prepared subgrade for payment by the square yards of subgrade prepared, protected, and accepted.

The Engineer shall measure brick joint restoration for payment by the square yards of brick joint restored and accepted.

The Engineer shall concrete delineation strip construction for payment by the linear feet of concrete delineation strip constructed and accepted.

Payment shall be made under the following unless otherwise indicated in the Contract Documents. The Contract Price shall be full compensation for furnishing all labor, materials, equipment, tools, and all incidentals necessary to complete the work.
<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Repair Brick Pavement</td>
<td>Square Yard</td>
</tr>
<tr>
<td>Repair Brick Pavement Subgrade – Aggregate</td>
<td>Square Yard</td>
</tr>
<tr>
<td>Repair Brick Pavement Subgrade – Concrete</td>
<td>Square Yard</td>
</tr>
<tr>
<td>Protection of Prepared Subgrade</td>
<td>Square Yard</td>
</tr>
<tr>
<td>Restore Brick Joint</td>
<td>Square Yard</td>
</tr>
<tr>
<td>Construct Concrete Delineation Strip</td>
<td>Linear Foot</td>
</tr>
</tbody>
</table>
1004  Sewer Repair

1004.01 General

A. Description
   This work includes repair of sewers, installation of frame seals on existing manholes, replacement of precast inlet tops, and adjustments of grate inlets. Removal of existing materials shall be in accordance with Section 100. Replacement of the removed materials shall be in accordance with the applicable Sections and Standard Plates.

B. Submittal Requirements
   Refer to Section 1000.01 B for submittal requirements.

1004.02 Material Requirements

A. General
   Refer to Section 1000.02 for general material requirements. Additional material requirements shall be in accordance with the applicable Sections.

1004.03 Construction Requirements

A. General
   Refer to Section 1000.03 for general construction requirements, in addition to the following requirements.
   The Contractor shall deliver broken or unserviceable manhole rings and covers to the City and pick up replacements. This work shall be considered incidental to other items for which the Contract provides direct payment.

B. Sewer Repair
   Sewers to be repaired shall be removed as indicated in the Contract Documents and in accordance with Section 100. Saw-cut and remove pavement in accordance with Section 1000.03. Remove damaged pipe and provide a neat and clean vertical edge on existing pipe to remain in place. Install flexible transition couplings and pipe in accordance with Section 700. Backfill shall be in accordance with Section 700. Pavement reconstruction shall be in accordance with Section 1000.03.

C. External Frame Seals
   Pavement removal shall be in accordance with Section 1000.03. External frame seals shall be installed in accordance with Section 700. When indicated in the Contract Documents or as directed by the Engineer, manholes shall be reconstructed in accordance with Section 700. Backfill shall be in accordance with Section 700. Pavement shall be reconstructed in accordance with Section 1000.03.

D. Adjusting Grate Inlets
   Remove all surrounding materials from the inlet as needed to accomplish the adjustment. Saw-cut and remove pavement in accordance with Section 1000.03. Adjust grate inlets in accordance with Standard Plate 1002-01. Replace surrounding materials to match the existing condition unless otherwise indicated in the Contract Documents, or as directed by the Engineer.
E. Solid Manhole Covers

The Contractor shall remove vented sanitary manhole frames and covers from existing sanitary manholes and replace with new non-vented sanitary manhole frames and covers as indicated in the Contract Documents and in accordance with the Standard Plates. This work shall include delivery of removed vented manhole frames and covers to City Sewer Maintenance. Existing frames and covers shall be measured to verify the replacement non-vented frames and covers are of correct diameter. Pavement removal and reconstruction shall be in accordance with Section 1002 and paid for separately.

F. Precast Curb Inlet Tops

The Contractor shall remove existing precast curb inlet tops and replace with new precast curb inlet tops as indicated in the Contract Documents. New curb inlet tops shall be in accordance with Section 700 and Standard Plate 702-10.

G. Sanitary Sewer Taps

The Contractor shall tap existing sanitary sewer pipes and manholes in accordance with the Contract Documents and Standard Plate 700-02. The City reserves the right to review proposed plans for taps into existing structures or utilities. Materials used to construct the tap shall be in accordance with Section 700. New pipe connections shall be pre-fabricated (e.g. tees, wyes). Flowlines of new taps shall match existing flow lines of the pipe or manhole being tapped. Installation of new taps and associated pipe materials shall be in accordance with Section 700.

H. Rebuilding Manholes for External Frame Seal Installation

The Contractor shall rebuild manholes in accordance with the Contract Documents and Section 700 to install external frame seals. Materials used to rebuild manholes shall be in accordance with Section 700. Installation of frame seals shall be in accordance with Section 700.

1004.04 Acceptance

The Engineer shall observe the work to check for compliance with the Contract Documents. Acceptance requirements shall be in accordance with Sections 500 and 700. Sewer repairs shall be constructed to the minimum compressive strength requirements identified in the Contract Documents. The Engineer shall verify the compressive strength of the concrete in accordance with the City of Omaha Materials and Testing Manual for Public Works Construction. Unless otherwise directed by the Engineer, sewer repairs not meeting the acceptance requirement(s) shall be removed and replaced at no additional cost to the City.

1004.05 Measurement and Payment

The Engineer shall measure sewer repairs for payment by the linear feet of sewer excavated, removed, repaired, backfilled, and accepted. Pavement removal and replacement shall be measured and paid in accordance with Section 1003.05.

The Engineer shall measure external frame seals installation on existing manholes for payment by each external frame seal supplied, installed, and accepted. Payment shall be full compensation for pavement removal and disposal, excavation, furnishing and installing the external frame seal, backfilling, and replacing pavement.

The Engineer shall measure grate inlet adjustments for payment by each grate inlet adjusted and accepted.
The Engineer shall measure installing solid manhole frames and covers for payment by each solid manhole frame and cover removed, replaced, installed, and accepted. Payment shall be full compensation for each solid manhole frame and cover removed and delivered to Sewer Maintenance, and for furnishing and installing a new frame and cover.

The Engineer shall measure removing and replacing precast inlet tops for payment by each precast inlet top removed, replaced and accepted. Payment shall be full compensation for inlet top removal and disposal, excavation, furnishing and installing the new precast inlet top, grading, seeding, and sodding.

The Engineer shall measure constructing sanitary sewer taps for payment by each tap excavated, constructed, backfilled, and accepted.

The Engineer shall measure rebuilding manholes for external frame seal installations for payment by each manhole removed, rebuilt, backfilled, and accepted. Unless otherwise indicated in the Contract Documents, frame seal installation shall be measured and paid for separately.

Payment shall be made under the following unless otherwise indicated in the Contract Documents. The Contract Price shall be full compensation for furnishing all labor, materials, equipment, tools, and all incidentals necessary to complete the work.

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Repair Sewer</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Install External Frame Seal on Existing Storm Sewer Manhole</td>
<td>Each</td>
</tr>
<tr>
<td>Install External Frame Seal on Existing Sanitary Sewer Manhole</td>
<td>Each</td>
</tr>
<tr>
<td>Adjust Grate Inlet</td>
<td>Each</td>
</tr>
<tr>
<td>Install Frame and Solid Manhole Cover</td>
<td>Each</td>
</tr>
<tr>
<td>Remove and Replace Precast Inlet Top</td>
<td>Each</td>
</tr>
<tr>
<td>Construct Sanitary Sewer Tap</td>
<td>Each</td>
</tr>
<tr>
<td>Rebuild Manhole for External Frame Seal Installation</td>
<td>Each</td>
</tr>
</tbody>
</table>
SECTION 1100 – MISCELLANEOUS ITEMS

1100 Miscellaneous Items

1100.01 General

A. Description

The information, submittal and material requirements, and construction requirements of this section shall apply to all subsections within Section 1100 unless otherwise specified. This section includes providing public information services, sprinkler systems, mailboxes, field offices, precast concrete pavers, granite curbs, anti-graffiti coating, equipment rental, mobilization/demobilization, and towing.

B. Submittal Requirements

The Contractor shall submit, in accordance with the General Conditions, the following submittals:

1. New sprinkler system components and material certifications, and manufacturer’s installation recommendations.
2. Sprinkler system installation record drawing with dimensions, including all changes and/or modifications to the existing systems.
3. Precast concrete paver material certifications and manufacturer’s installation recommendations.
4. Precast concrete paver representative sample to show full range of color variation that can be expected in the finished work, for each color of paver specified.
5. Bituminous concrete setting bed material certifications and manufacturer’s installation recommendations.
6. Neoprene tack coat material certifications and manufacturer’s installation recommendations.
7. Stone dust or silica sand joint filler material certifications and manufacturer’s installation recommendations.
8. Precast concrete paver sealant material certifications and manufacturer’s installation recommendations.
9. Anti-graffiti coating manufacturer relevant experience of a minimum of five (5) years.
10. Anti-graffiti coating installation contractor relevant experience of a minimum of three (3) years.
11. Anti-graffiti coating material certifications and manufacturer’s installation recommendations, including acknowledgement of the compatibility of the coating material with the prepared surface on which it is proposed to be applied.

1100.02 Material Requirement

Refer to subsequent sections in 1100 for material requirements.
1100.03 Construction Requirements

Refer to subsequent sections in 1100 for construction requirements.
1101 Public Information Services

1101.01 General

A. Description
This work includes providing public information services from commencement to final completion of the work as described in the Contract Documents.

B. Submittal Requirements
None.

1101.02 Material Requirements

A. General
None.

1101.03 Construction Requirements

A. General
Designate a single person employed or sub-contracted by the Contractor as the individual responsible for maintaining communications with the Engineer, local residents, and businesses. Provide a public office that is open a minimum of four (4) hours each working day and is equipped with a local call line and an answering service. The answering service shall allow callers to leave a message and provide callers information on office hours and current and future work. Monitor the answering service a minimum of one (1) time every twelve (12) hours. The Contractor's regular office call line or cellular telephone lines are acceptable provided such lines are local call lines.

The designated individual shall respond to all questions concerning activities and schedules of the work and participate in all meetings pertaining to the work between local residents and businesses, the Engineer, and the Contractor. Maintain a log of local resident and business contact names, addresses, and telephone numbers. Document all meetings and conversations and any subsequent action taken and provide such documentation to the Engineer upon request.

Prepare and distribute fliers to local residents and businesses directly adjacent to the limits of the project a minimum of seven (7) days before beginning construction of the project. The flier shall identify the designated contact person, location of the public office, hours of the public office, local call line, scope of the work, anticipated start and completion dates, and detailed schedule for the first twenty-eight (28) days. As the work progresses, the Contractor shall prepare and distribute additional fliers to local residents and businesses that are directly impacted as the work areas change.

1101.04 Acceptance
The Engineer shall observe the Contractor’s public information services to check for compliance with the Contract Documents.

1101.05 Measurement and Payment
The Engineer shall measure public information services for payment by a lump sum of the public information services provided and accepted. Payment may be made incrementally as determined by the Engineer.
Payment shall be made under the following unless otherwise indicated in the Contract Documents. The Contract Price shall be full compensation for providing public offices, local call lines, answering services, and documentation; providing and maintaining a log; attending meetings; supplying and distributing fliers; and for furnishing all labor, materials, equipment, tools, and all incidentals necessary to complete the work.

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public Information Services</td>
<td>Lump Sum</td>
</tr>
</tbody>
</table>
1102 Sprinkler Systems

1102.01 General

A. Description
This work includes removing, installing, relocating, reconnecting, and/or repairing sprinkler systems.

B. Submittal Requirements
Refer to Section 1100.01 B for submittal requirements.

1102.02 Material Requirements

A. Sprinkler Systems
Sprinkler system components and materials shall match existing sprinkler system components for existing systems. Sprinkler system components and materials for new installations shall be a commercially manufactured sprinkler system. Distribution lines shall consist of the lines between the valve box and sprinkler heads.

B. Trunk Lines
Trunk lines shall consist of the backflow preventer and the pressurized pipe between the water source and valve box. All materials shall meet the applicable local plumbing codes.

1102.03 Construction Requirements

A. General
Individuals or firms whose primary business is lawn sprinkler installation and repair shall perform all sprinkler system removal, installation, relocation, reconnection, and repair work. The Contractor shall be responsible for locating and identifying all components of the system(s) prior to removal and reinstallation.

A licensed plumber shall install trunk lines and backflow preventers as required in applicable local plumbing codes.

The Contractor shall repair and/or replace any damaged sprinkler system component that is not designated for removal and/or that does not fall within the construction limits at no additional cost to the City.

B. Removal
Remove sprinkler systems including sprinkler heads, distribution and trunk lines, valve boxes, wiring, and system control/timer boxes to the limits identified in the Contract Documents. Preserve all removed components to allow for reinstallation. Install caps on all partially removed lines to permit use of the unaffected system. Adjust remaining sprinkler system heads to avoid damage to the work area. Install caps on all abandoned lines left in place.

C. Installation, Relocation, and Reconnection
Install new sprinkler systems including sprinkler heads, distribution and trunk lines, valve boxes, wiring, and system control/timer boxes in accordance with the manufacturer's recommendations.

Relocate and/or reconnect existing distribution and trunk lines, sprinkler heads, valve boxes, wiring, and system control/timer boxes to completely water the area and/or to replicate the pre-construction watering pattern.
Field designs of sprinkler systems shall be reviewed and accepted by the Engineer prior to constructing or repairing existing systems.

D. Repair

Repair any damaged sprinkler systems within twenty-four (24) hours to reestablish the functionality and coverage of the system as it operated prior to damage. Repair damaged sprinkler systems at no additional cost to the City.

1102.04 Acceptance

The Engineer shall observe the work to check for compliance with the Contract Documents.

The Contractor shall be responsible for any plumbing inspections as required in applicable local plumbing codes.

Notify the Engineer twenty-four (24) hours in advance of system(s) pressurization and testing. The Contractor shall be responsible for pressurizing, testing and adjustments necessary to ensure proper watering coverage of all irrigated areas. Adjustments and repairs to damaged systems shall be performed at no additional cost to the City.

The Contractor and property owner(s) shall review the system(s) after becoming operational to verify proper coverage of the irrigated area(s) and overall functionality of the system. The Contractor shall provide detailed record drawings with dimensions of each property showing the new sprinkler system layout. The Engineer will visually inspect the systems to verify proper operation and water coverage of the irrigated areas.

1102.05 Measurement and Payment

Removal of existing sprinkler system components shall be subsidiary to items for which the Contract provides direct payment.

The Engineer shall measure removal and installation of new sprinkler system heads for payment by each new sprinkler system head installed, adjusted, and accepted. The removal of existing sprinkler system heads shall be subsidiary to items for which the Contract provides direct payment.

The Engineer shall measure removal and installation of new sprinkler system distribution lines for payment by the linear feet of new sprinkler system distribution line installed and accepted. The removal of existing sprinkler system distribution lines shall be subsidiary to items for which the Contract provides direct payment.

The Engineer shall measure removal and installation of new sprinkler system trunk lines for payment by the linear feet of new sprinkler system trunk line installed and accepted. The removal of existing sprinkler system trunk lines shall be subsidiary to items for which the Contract provides direct payment.

The Engineer shall measure removal and installation of new sprinkler system valve boxes for payment by each new sprinkler system valve box installed and accepted. The removal of existing sprinkler system valve boxes shall be subsidiary to items for which the Contract provides direct payment.

The Engineer shall measure removal and installation of new sprinkler system control/timer boxes for payment by each new sprinkler system control/timer box installed and accepted. The removal of existing sprinkler system control/timer boxes shall be subsidiary to items for which the Contract provides direct payment.
The Engineer shall measure removal and installation of new sprinkler system backflow preventers for payment by each new sprinkler system backflow preventer installed and accepted. The removal of existing sprinkler system backflow preventers shall be subsidiary to items for which the Contract provides direct payment.

Payment shall be made under the following unless otherwise indicated in the Contract Documents. The Contract Price shall be full compensation for removal and capping of the existing system distribution lines and heads; for providing and installing new control systems, new distribution lines and/or trunk lines, new sprinkler heads, new backflow preventers, connections to water sources, and detailed record drawings; and for furnishing all labor, materials, equipment, tools, and all incidentals necessary to complete the work.

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remove and Install New Sprinkler System Head</td>
<td>Each</td>
</tr>
<tr>
<td>Remove and Install New Sprinkler System Distribution Line</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Remove and Install New Sprinkler System Trunk Line</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>Remove and Install New Sprinkler System Valve Box</td>
<td>Each</td>
</tr>
<tr>
<td>Remove and Install New Sprinkler System Control/Timer Box</td>
<td>Each</td>
</tr>
<tr>
<td>Remove and Install New Sprinkler System Backflow Preventer</td>
<td>Each</td>
</tr>
</tbody>
</table>
1103 Mailboxes

1103.01 General
   A. Description
      This work includes removal, temporary relocation, reinstallation, and/or replacement of mailboxes and posts.

   B. Submittal Requirements
      None.

1103.02 Material Requirements
   A. Mailboxes and Posts
      Mailboxes and posts shall be in accordance with the United States Postal Service Postal Operations Manual 632. Replacement mailboxes are subject to the approval of the United States Postmaster.

1103.03 Construction Requirements
   A. General
      Remove, salvage, store, and protect mailboxes and posts intended for reinstallation. Replace mailboxes or posts that the Engineer deems unacceptable for reuse. Repair or replace any mailboxes or posts damaged by negligent actions of the Contractor at no cost to the City.

      Install and maintain temporary mailboxes at the locations indicated in the Contract Documents or as directed by the Engineer. Install temporary mailboxes at the proper height as directed by the United States Postmaster. Anchor temporary mailboxes to prevent unintentional movement.

      Install new or relocated mailboxes at the final locations as indicated in the Contract Documents or as directed by the Engineer. Install such mailboxes at the proper height and locations as directed by the United States Postmaster.

1103.04 Acceptance
   The Engineer shall observe the work to check for compliance with the Contract Documents.

1103.05 Measurement and Payment
   The Engineer shall measure the removal and reinstallation of mailboxes for payment by each mailbox post removed, stored, reinstalled, and accepted. Attaching mailboxes to the posts, regardless of the number of mailboxes attached to an individual post, is subsidiary to items for which the Contract provides direct payment. The Engineer shall measure the replacement of mailbox(es) and post(s) deemed unacceptable for reinstallation, due to no fault of the Contractor, for payment by the number of replacement mailbox(es) and post(s) supplied, installed, and accepted. This price shall be full compensation for materials only, and be paid for at invoice cost to the Contractor.

   The Engineer shall measure the installation of temporary mailboxes for payment by each mailbox post installed and accepted. Attaching mailboxes to the posts, regardless of the number of mailboxes attached to an individual post, is subsidiary to items for which the Contract provides direct payment. Removal of temporary mailboxes upon completion of the work is subsidiary to items for which the Contract provides direct payment.
The Engineer shall measure the installation of new mailboxes for payment by each mailbox post installed and accepted. Attaching mailboxes to the posts, regardless of the number of mailboxes attached to an individual post, is subsidiary to items for which the Contract provides direct payment.

Payment shall be made under the following unless otherwise indicated in the Contract Documents. The Contract Price shall be full compensation for furnishing all labor, materials, equipment, tools, and all incidentals necessary to complete the work.

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remove and Reinstall Mailbox Post</td>
<td>Each</td>
</tr>
<tr>
<td>Install Temporary Mailbox Post</td>
<td>Each</td>
</tr>
<tr>
<td>Install Mailbox Post</td>
<td>Each</td>
</tr>
</tbody>
</table>
1104 Field Office

1104.01 General
   A. Description
      This work includes furnishing and placing a field office, of the type(s) specified in the Contract Documents, at the project for the exclusive use of and control by the Engineer for performing testing required to control the work, for making reports, and for proper storage of equipment and project records.

   B. Submittal Requirements
      None.

1104.02 Material Requirements
   A. Field Offices
      Field offices shall consist of wood, metal-covered wood, metal, masonry block, or other similar structure. Provide screens and locks on all exterior doors and windows.

      Furnish constant electricity (120, 220, and 240 volts AC as required) to the field office sufficient to power lights, heating and cooling systems, and all necessary equipment. Maintain the electricity during non-working hours. Furnish a communication line to the field office to provide internet access to computers or other equipment. Maintain the communication line during non-working hours. Equip the field office with a heating and cooling system capable of maintaining the inside temperature between sixty-five (65) and eighty (80) degrees Fahrenheit. Furnish all necessary fuel or other energy sources required by the heating and cooling system.

      Equip each office with a commercial Underwriters' Laboratory approved fire extinguisher capable of controlling fires of paper, wood, rubbish, etc. Service and maintain the fire extinguisher to a full and operative condition at all times during the use of the office.

      Field offices shall have minimum interior dimensions of nine (9) feet wide and seven (7) feet high with a minimum floor area of two hundred twenty-five (225) square feet. Equip field offices with a minimum of two (2) exterior doors and four (4) sliding- or swinging-type windows. Furnish the field office with a large table and chairs for conducting meetings. Furnish a desk and file cabinet for the Engineer's use during the project. Furnish a minimum of eight (8) conveniently located duplex wall outlets and two (2) communication line wall outlets.

1104.03 Construction Requirements
   A. General
      Place the field office level and solidly supported at locations near the work, away from sources of vibration, or as directed by the Engineer. Relocate the field office as necessary due to progress of the work or as directed by the Engineer. The Contractor shall connect all utilities to the office or building. Field office shall not be placed until contracts have been fully executed, unless otherwise directed by the Engineer.

1104.04 Acceptance
   The Engineer shall observe the work to check for compliance with the Contract Documents.
1104.05 Measurement and Payment

Unless otherwise indicated in the Contract Documents, field offices, all related utilities and services, and all other work associated with field offices shall be subsidiary to items for which the Contract provides direct payment.

The Engineer shall measure the providing field offices for payment by each field office provided and accepted.

Payment shall be made under the following unless otherwise indicated in the Contract Documents. The Contract Price shall be full compensation for furnishing all labor, materials, equipment, tools, and all incidentals necessary to complete the work.

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provide Field Office</td>
<td>Each</td>
</tr>
</tbody>
</table>

1105  Precast Concrete Pavers for Pavement and Sidewalk

1105.01 General

A. Description
This work includes supplying and constructing precast concrete pavers for pavement and sidewalk on a concrete base along the lines, grades, and dimensions indicated in the Contract Documents or as directed by the Engineer.

B. Submittal Requirements
Refer to Section 1100.01 B for submittal requirements.

1105.02 Material Requirements

A. Rigid Pavement Base
Concrete material for paver base shall be in accordance with Section 500.

B. Precast Concrete Pavers
Pavers shall be manufactured in one (1) step as a homogenous mixture. No laminated products shall be accepted. The manufacturer shall have been producing pavers meeting these specifications for a minimum of five (5) years and shall demonstrate the capability to produce the contract quantity in accordance with the project schedule. Pavers shall be manufactured utilizing automatic, vibrating, hydraulic press equipment that has been intended for manufacture of the product. Pavers shall be manufactured in accordance with ASTM C936, Standard Specification for Solid Concrete Interlocking Paving Units, except as modified herein. Compressive strength shall be a minimum of eight-thousand five-hundred (8,500) average pounds per square inch after twenty-eight (28) days, and density shall be a minimum of one-hundred forty (140) pounds per cubic foot. Size, color, and finish of pavers shall be in accordance with the Contract Documents. All pavers to be used for the project shall be manufactured from the same respective lot, and shipped to the Contractor at the same time, regardless of project phasing.

C. Bituminous Concrete Setting Bed
Asphalt cement to be used in the bituminous setting bed shall meet the requirements for viscosity grade A.C. 10 or A.C. 20 in accordance with Table 1 of ASTM D3381, Standard Specification for Viscosity-Graded Asphalt Cement for Use in Pavement Construction.

Fine aggregate to be used in the bituminous setting bed shall be clean, hard sand with durable particles and free from adherent coating, clay lumps, alkali salts, and organic matter, and be uniformly graded and passing the No. 4 sieve when tested in accordance with ASTM C136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.

The bituminous concrete setting bed shall be manufactured by combining the fine aggregate with hot asphalt cement and heated to approximately three-hundred (300) degrees Fahrenheit. The approximate proportion of materials shall be seven (7) percent asphalt cement and ninety-three (93) percent fine aggregate. Each ton of mix shall be apportioned by weight in the approximate ratio of one-hundred forty-five (145) pounds of asphalt cement to one-thousand eight-hundred fifty-five (1,855) pounds of fine aggregate. The Contractor shall determine the exact proportions to produce the exact mixture required for construction of the bituminous setting bed.
D. Sand Setting Bed
Sand to be used for the setting bed shall meet the requirements for fine aggregate in accordance with ASTM C33, Standard Specification for Concrete Aggregates. Sand shall be uniform in type and moisture content.

E. Prime Coat
Prime coat for application under the bituminous setting bed shall be Type CRS-1 in accordance with ASTM D2397, Standard Specification for Cationic Emulsified Asphalt.

F. Neoprene Tack Coat
Neoprene tack coat for use beneath pavers shall be a neoprene modified asphalt adhesive consisting of a two (2) percent neoprene base with ten (10) percent structural fibers and eighty-eight (88) percent asphalt. The melting point shall be a minimum of two-hundred (200) degrees Fahrenheit, with penetration of twenty-three (23) to twenty-seven (27) at seventy-seven (77) degrees Fahrenheit using a one-hundred (100) gram load for five (5) seconds, when tested in accordance with ASTM D36, Standard Test Method for Softening Point of Bitumen (Ring and Ball Apparatus).

G. Stone Dust or Silica Sand Joint Filler
Stone dust or silica sand for use in vertical paver joints shall consist of inert materials that are hard, durable stone or sand free from surface coatings and deleterious materials. Gradation requirements shall be in accordance with Table 1105.01.

<table>
<thead>
<tr>
<th>Table 1105.01</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gradation Requirements</td>
</tr>
<tr>
<td><strong>Sieve Size</strong></td>
</tr>
<tr>
<td>#4</td>
</tr>
<tr>
<td>#8</td>
</tr>
<tr>
<td>#16</td>
</tr>
<tr>
<td>#30</td>
</tr>
<tr>
<td>#50</td>
</tr>
<tr>
<td>#100</td>
</tr>
<tr>
<td>#200</td>
</tr>
</tbody>
</table>

1105.03 Construction Requirements

A. General
Precast concrete pavers for pavement and sidewalk shall be constructed in accordance with Standard Plate 1105-01.

B. Storage and Handling
Precast concrete pavers shall be delivered on pallets. Damaged pavers shall be removed and replaced at the Contractor’s expense. Pavers shall be stored on raised platforms, and located to avoid or be protected from traffic. Stone dust shall be delivered in a dry condition. All materials shall be stored in manufacturer’s packaging in a dry and covered condition until they are to be installed.
C. **Concrete Base**

Concrete base for pavers shall be constructed in accordance with Section 500, and to the dimensions and elevations indicated in the Contract Documents or as directed by the Engineer.

D. **Bituminous Setting Bed**

The concrete base shall be thoroughly cleaned and prepared by removing any dirt, grit, grease, or surface imperfections. The prime coat of emulsified asphalt shall be applied to the concrete base.

Prior to placement of the bituminous setting bed, three-fourth (¾) inch solid steel depth control bars shall be placed directly on the concrete base. If grades must be adjusted, wood chocks shall be set under the depth control bars to the proper grade. Set two (2) bars parallel to each other to serve as guides for the striking board. The depth control bars shall be set carefully to bring the pavers, when laid, to proper grade. Depth control bars greater than three-fourth (¾) inch deep may be used to provide proper surface drainage in certain areas.

The setting bed shall be rolled with a power roller to a nominal depth of three-fourth (¾) inch while still hot. This thickness shall be adjusted so that when the pavers are placed and rolled, the top surface of the pavers will be at the required finished grade.

E. **Neoprene Tack Coat**

A coating of two (2) percent neoprene-modified asphalt adhesive shall be applied using a mop or trowel over the top surface of the bituminous setting bed to provide a bond under the pavers. If it is troweled, the trowel shall be serrated with serrations not to exceed one-sixteenth (⅛) inch.

F. **Sand Setting Bed**

The sand setting bed shall be a uniform level of one (1) inch of sand after vibration and compaction. The final surface level should be checked at frequent intervals to provide a smooth surface. If the final surface level is incorrect, the Contractor shall rake and re-level and recompact at no additional cost to the City.

G. **Concrete Pavers**

No pavers shall be laid in inclement weather or when the temperature is thirty-six (36) degrees Fahrenheit or lower.

The concrete pavers shall be carefully placed by hand in straight or radial courses as indicated in the Contract Documents, with hand tight joints and uniform top surface. Pavers shall be brought to the finish grade, and the maximum deviation from grade shall be less than one-fourth (¼) inch in ten (10) feet. All finish-paved areas shall slope to drain at a minimum of one-eighth (⅛) inch per foot, or as indicated in the Contract Documents.

All cutting and patching required to complete the work shall be performed with a water-cooled radial cut-off type masonry saw to provide a sharp, straight edge.

Paver installation shall be true to the lines and grades indicated in the Contract Documents. Finished work shall slope evenly between edges. Pavers at edges shall be flush with adjacent pavements or tops of curbs. Care shall be taken during the layout to minimize cutting of pavers.
General sequence of paver construction shall be as follows:

1. Starting at a ninety (90) degree corner or straight edge, commence laying the pavers one-eighth (⅛) inch from the building or paving edge on the undisturbed setting bed in the pattern indicated in the Contract Documents.

2. Pavers shall be installed hand tight to achieve butt joints. String lines shall be used frequently to hold pattern lines true and accurate, either parallel to the edge restraints or ninety (90) degrees to the edge restraints indicated in the Contract Documents.

3. Full units shall be laid first and cuts done subsequently. Use manufactured edge pieces or, as required, cut full units so all cuts fit neatly and accurately without damaged edges. The Contractor shall set subsequent pavers by moving forward on the top of the previously installed units. Work shall proceed uphill. The Contractor shall pave the entire area, leaving no greater than one-eight (⅛) inch joints, without using paver pieces of less than two (2) inches in any dimension.

4. Newly laid pavers shall be protected at all times by panels of plywood. These panels may be advanced as work progresses, however the plywood protection shall be kept in areas which will be subjected to continued movement of materials and equipment. The Contractor shall protect the paver alignment to avoid depressions. Do not transport materials, or drive trucks or machinery over pavers following installation.

H. Compaction

After a substantial area of pavers have been installed and at the end of each work day, a plate vibrator fitted with a rubber mat base, with high frequency, low amplitude shall be used to tamp the pavers into place. Do not over compact. Take special precautions to eliminate the potential of paver settlement at all placement edges and intersections.

I. Stone Dust or Silica Sand

After all pavers have been installed, sweep stone dust or silica sand into the paver joints until joints are filled solid. Lightly fog with water and sweep additional dust or sand and repeat a minimum of three (3) times.

Remaining stone dust or sand shall be swept into the joints of pavers until they are filled flush to the top of the paving stones. Sweep excess stone dust from the paving surface.

J. Completion of Paver Installation

Approximately two (2) weeks following the placement of filler stone dust or silica sand on top of the pavers, the completed paver surface shall be swept clean and washed down with water to provide a clean and neat installation. Any areas where the pavers are not flush with adjacent pavements or where depressions in the paving surface have occurred, will be removed and reinstalled to the correct elevation.

1105.04 Acceptance

The Engineer shall observe the work to check for compliance with the Contract Documents. Acceptance requirements shall be in accordance with Section 500. Concrete bases shall be constructed to the minimum compressive strength requirements identified in the Contract Documents. The Engineer shall verify the compressive strength of the concrete in accordance with the City of Omaha Materials and Testing Manual for Public Works Construction.
1105.05 Measurement and Payment

The Engineer shall measure precast concrete pavers for pavement for payment by the square yards of precast concrete pavers for pavement supplied, constructed, and accepted. Construction of concrete base, prime coat, bituminous concrete setting bed, neoprene tack coat, and joint filler shall be considered subsidiary to items for which the Contract provides direct payment.

The Engineer shall measure precast concrete pavers for sidewalk for payment by the square feet of precast concrete pavers for sidewalk supplied, constructed, and accepted. Construction of concrete base, prime coat, bituminous concrete setting bed, neoprene tack coat, and joint filler shall be considered subsidiary to items for which the Contract provides direct payment.

Cushion sand shall be subsidiary to items for which the Contract provides direct payment.

Payment shall be made under the following unless otherwise indicated in the Contract Documents. The Contract Price shall be full compensation for supplying and installing all precast concrete pavers, concrete base, prime coat, setting bed, tack coat, joint filler, forms, and expansion joints; and for furnishing all labor, materials, equipment, tools, and all incidentals necessary to complete the work.

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construct Precast Concrete Pavers for Pavement</td>
<td>Square Yard</td>
</tr>
<tr>
<td>Construct Precast Concrete Pavers for Sidewalk</td>
<td>Square Foot</td>
</tr>
</tbody>
</table>
1106  Granite Curb

1106.01 General
   A. Description
      This work includes constructing granite curb on a prepared subgrade, base, or subbase in accordance with the lines, grades, and dimensions indicated in the Contract Documents or as directed by the Engineer.
   B. Submittal Requirements
      None.

1106.02 Material Requirements
   A. Concrete Base
      Refer to Section 500 for general material requirements.
   B. Granite Curb
      Unless otherwise indicated in the Contract Documents, the Contractor shall supply the granite curb.

1106.03 Construction Requirements
   A. General
      Granite curb shall be constructed in accordance with the details and requirements indicated in the Contract Documents and Standard Plate 1106-01.

1106.04 Acceptance
   The Engineer shall observe the work to check for compliance with the Contract Documents. Concrete bases shall be constructed to the minimum compressive strength requirements identified in the Contract Documents. The Engineer shall verify the compressive strength of the concrete in accordance with the City of Omaha Materials and Testing Manual for Public Works Construction.

1106.05 Measurement and Payment
   The Engineer shall measure granite curbs for payment by the linear feet of granite curb supplied, constructed, and accepted.

   Payment shall be made under the following unless otherwise indicated in the Contract Documents.
   The Contract Price shall be full compensation for supplying and installing the granite curb; for constructing the concrete base, backing, shims, grout, expansion joint, and plastic wrap; and for furnishing all labor, materials, equipment, tools, and all incidentals necessary to complete the work.

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construct Granite Curb</td>
<td>Linear Foot</td>
</tr>
</tbody>
</table>
1107 Anti-Graffiti Coating

1107.01 General

A. Description
This work includes applying a non-sacrificial, matte gloss anti-graffiti protective coating over prepared surfaces in accordance with manufacturer’s recommendations, and as indicated in the Contract Documents or as directed by the Engineer. Structures receiving anti-graffiti coating application shall be constructed in accordance with Section 600 and the Contract Documents.

B. Submittal Requirements
Refer to Section 1100.01 B for submittal requirements.

1107.02 Material Requirements

A. Anti-Graffiti Coating
Anti-graffiti coating shall be a urethane based sealant which provides an invisible, non-sacrificial penetrating barrier. Coating shall dry as a matte or satin finish; high gloss finish is unacceptable. Coating shall be a low volatile organic content (VOC) material with a VOC rating of less than three and three-tenths (3.3) pounds per gallon. Coating shall be resistant to weather humidity, abrasion, acid, alkali, salt spray, ultra-violet rays, and petroleum products. Coating shall allow vapor transmission in accordance with ASTM E-96, Standard Test Methods for Water Vapor Transmission of Materials. The application of the coating shall not result in yellowing or color change to the surface to which the coating is applied. Coating shall have the capability of having all types of paints and graffiti materials completely removed without damaging the surface to which the coating is applied. Removal of graffiti shall not result in “shadowing” of the surface upon removal of graffiti. Manufacturer recommended cleaning products for removal of graffiti shall be non-toxic and biodegradable. Provide all coating materials in sealed containers that are clearly labeled to allow verification with applicable material safety data sheets, application precautions, and instructions. Labeling shall include the manufacturer’s name, type of material, brand name, gloss designation, date of manufacture, shelf life, contract or order number under which the material has been ordered, lot and batch numbers, quantity, handling, thinning, and application instructions.

1107.03 Construction Requirements

A. Test Sample
The Contractor shall apply the anti-graffiti coating material on a sample section of the prepared surface to demonstrate the application, appearance and compatibility of the anti-graffiti coating with the prepared surface. The Contractor shall arrange for a review by the Engineer of the completed sample. Acceptance of the sample section shall be obtained before starting the work, and shall be the standard by which remaining work will be evaluated and accepted.

B. Protection of Surfaces and Surrounding Property
Use protective coverings, shields, or masking as necessary to protect surfaces that are not designated to receive anti-graffiti coating. Maintain protective coverings during the period during which work is being performed, and remove all coverings upon completion of the work. All costs associated with furnishing, installing, and removing protective coverings or other similar materials shall be considered subsidiary to items for which the Contract provides direct payment.
The Contractor shall be responsible for protecting vehicles, structures, buildings, vegetation, equipment, hardware, fixtures, and other materials from over spray, spillage, and other similar damage resulting from anti-graffiti coating installation. The Contractor shall be responsible for the cleanup of any spills. The Contractor shall coordinate with adjacent buildings and property owners to prevent fumes from entering. The Contractor shall maintain adequate ventilation when working in confined areas. Over spray to surrounding surfaces or property shall be removed in accordance with the manufacturer’s recommendations. All costs associated with protecting surrounding property, cleaning up spills, or removing over spray shall be considered subsidiary to items for which the Contract provides direct payment.

C. Technical Representation by Material Manufacturer

The Contractor shall arrange for a technical representative of the material manufacturer to visit the site to review the quality of surface preparation and product application method. The Engineer may request additional visit(s) if corrective action is needed. The Contractor shall have the material manufacturer summarize the results of the inspection(s) in writing and provide copies of the report(s) to the Engineer.

D. Surface Preparation

The Contractor shall protect new construction from graffiti prior to application of anti-graffiti coating. Any graffiti that does occur prior to application of anti-graffiti coating shall be completely removed at the Contractor’s expense prior to applying coating.

Surfaces to be treated shall be clean, dry, and free of oil, dirt, grease, efflorescence or any other coating, which may inhibit penetration and adhesion of anti-graffiti coating. If the surface requires cleaning prior to applying anti-graffiti coating, the Contractor shall clean the surface in accordance with manufacturer’s recommendations. All caulking shall be completed prior to application of anti-graffiti coating.

E. Application

Application shall be by means of brush, roller or sprayer in accordance with the manufacturer’s recommendations. The number of coats applied shall be in accordance with the manufacturer’s recommendations for compatibility with the prepared surface and to achieve a minimum ten (10) year warranty period.

For brush and roller application, the Contractor shall apply sufficient product to thoroughly saturate the surface. Avoid excessive overlapping and take care to brush out runs and drips to avoid excessive build-up.

For spray application, a low-pressure setting shall be used to avoid atomization of anti-graffiti coating material. Spray equipment shall be fitted with fan tip, stainless steel or brass fittings and gaskets suitable for solvent solutions. Follow each spray application with a clean bristle broom brushing to avoid excessive build-up.

F. Identification Signage Installation

Following installation of the anti-graffiti coating, the Contractor shall install two (2) identification signs (one on each end of the coated area), for each area being coated. Permanently affix the identification signs directly to the prepared surface in locations indicated in the Contract Documents or as directed by the Engineer.
G. Warranty

The Contractor shall be responsible for selecting and applying the product such that the product meets the manufacturer’s recommendations to achieve a ten (10) year material warranty period as defined by the manufacturer.

1107.04 Acceptance

The Engineer shall observe the work to check for compliance with the Contract Documents.

1107.05 Measurement and Payment

The Engineer shall measure anti-graffiti coatings for payment by the square feet of anti-graffiti coating supplied, constructed, and accepted.

Payment shall be made under the following unless otherwise indicated in the Contract Documents. The Contract Price shall be full compensation for supplying and installing the anti-graffiti coating; for constructing the test sample(s), installing identification signs, and providing product and installation certificates and warranties; and for furnishing all labor, materials, equipment, tools, and all incidentals necessary to complete the work.

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anti-Graffiti Coating</td>
<td>Square Foot</td>
</tr>
</tbody>
</table>
1108 Equipment Rental

1108.01 General

A. Description
This work includes furnishing, maintaining, providing fuel, and operating equipment in accordance with the lines, grades, and dimensions indicated in the Contract Documents or as directed by the Engineer.

B. Submittal Requirements
None.

1108.02 Material Requirements

A. Dump Truck
Dump trucks shall be standard make trucks having a manufacturer’s rating of at least two (2) tons. They shall be equipped with power-operated hoists and steel dump boxes of the end dump type having a volumetric struck capacity of at least five (5) cubic yards. Dump trucks shall be properly licensed and shall not exceed the statutory limitations in dimensions or wheel and axle loads. Dump trucks shall have all applicable insurance coverage.

B. Skid Loader
Skid loaders shall be loaders or tractors with pneumatic tires or rubber tracks, and shall have a minimum operating lifting capacity of one-thousand one-hundred (1,100) pounds.

C. Backhoe
Backhoes shall be crawler-type units capable of excavating soil in its original position and loading the excavated material into dump trucks. The minimum operating weight shall be thirteen and two-tenths (13.2) tons.

D. Loader
Loaders shall be rubber-tired or rubber-tracked units capable of lifting objects in its original position and loading the lifted material into dump trucks.

1108.03 Construction Requirements

A. General
Equipment shall be operated within all manufacturer’s operating parameters. Rental of each type of equipment shall include a licensed operator and a laborer.

1108.04 Acceptance
The Engineer shall observe the work to check for compliance with the Contract Documents.

1108.05 Measurement and Payment
The Engineer shall exclude from the measured time any time that is expended in moving to and from the work, other than necessary travel time within the project limits, time when no crew is available to operate the equipment, and time expended in repairing and servicing the equipment.

The cost of all repairs, operating costs, depreciation, insurance, taxes, and other incidental costs, including all wage expense incurred for operators, forepersons, supervisors, and timekeepers, is subsidiary to equipment rentals.
The Engineer shall measure delivery of dump trucks for payment by each dump truck delivered to the site and rented.

The Engineer shall measure delivery of skid loaders for payment by each skid loader delivered to the site and rented.

The Engineer shall measure delivery backhoes for payment by each backhoe delivered to the site and rented.

The Engineer shall measure delivery of loaders for payment by each loader delivered to the site and rented.

The Engineer shall measure rental of dump trucks for payment by the hours the dump truck is required by the Engineer at the site, even though the actual operation of the equipment, at times, may be intermittent.

The Engineer shall measure rental of skid loaders for payment by the hours the skid loader is required by the Engineer at the site, even though the actual operation of the equipment, at times, may be intermittent.

The Engineer shall measure rental of backhoes for payment by the hours the backhoe is required by the Engineer at the site, even though the actual operation of the equipment, at times, may be intermittent.

The Engineer shall measure rental of loaders for payment by the hours the loader is required by the Engineer at the site, even though the actual operation of the equipment, at times, may be intermittent.

Payment shall be made under the following unless otherwise indicated in the Contract Documents. The Contract Price shall be full compensation for supplying and operating the equipment when such equipment is not normally required in the performance of the other items of work in the Contract; providing a licensed operator and laborer; and for furnishing all labor, materials, equipment, tools, and all incidentals necessary to complete the work.

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deliver Dump Truck</td>
<td>Each</td>
</tr>
<tr>
<td>Deliver Skid Loader</td>
<td>Each</td>
</tr>
<tr>
<td>Deliver Backhoe</td>
<td>Each</td>
</tr>
<tr>
<td>Deliver Loader</td>
<td>Each</td>
</tr>
<tr>
<td>Rental of Dump Truck</td>
<td>Hour</td>
</tr>
<tr>
<td>Rental of Skid Loader</td>
<td>Hour</td>
</tr>
<tr>
<td>Rental of Backhoe</td>
<td>Hour</td>
</tr>
<tr>
<td>Rental of Loader</td>
<td>Hour</td>
</tr>
</tbody>
</table>
1109  Mobilization/Demobilization

1109.01  General

A. Description
This work includes preparatory work and operations necessary for the movement of personnel, equipment, supplies, and incidentals to the project site; and includes all other work and operations which must be performed or costs incurred before beginning work at the project site; in accordance with the lines, grades, and dimensions indicated in the Contract Documents or as directed by the Engineer.

B. Submittal Requirements
None.

1109.02  Material Requirements

A. General
None.

1109.03  Construction Requirements

A. General
The Contractor shall include all costs that they expect to incur for all movements of their equipment and personnel. Additional payments will not be made should the Contractor elect to move equipment and/or personnel to another project site before the contracted work is complete or if the Contractor fails to adequately assess the actual cost of mobilization for the contracted work.

Mobilization shall include the following items: providing required insurance certificates and bonds; obtaining required site permits, licenses, fees, and certificates; establishing field offices and furnishings as required by the Contract Documents; arranging for, preparing, and restoring work staging areas; establishing temporary construction utilities; and field location of existing utilities, unless included as a specific bid item.

Demobilization shall include removal of all equipment, material, and temporary facilities from the site, and site restoration as required by the Contract Documents, if not paid for under a separate bid item.

1109.04  Acceptance
The Engineer shall observe the work to check for compliance with the Contract Documents.

1109.05  Measurement and Payment

No measurement is required.

The Engineer shall recommend mobilization/demobilization for payment by a lump sum of the mobilization/demobilization provided, supplied, constructed, and accepted. Payment will be made incrementally over the first three (3) months of the project or as determined by the Engineer. The Contractor shall limit the value for mobilization/demobilization to no more than ten (10) percent of the total bid price.
Payment shall be made under the following unless otherwise indicated in the Contract Documents. The Contract Price shall be full compensation for furnishing all labor, materials, equipment, tools, and all incidentals necessary to complete the work.

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mobilization/Demobilization</td>
<td>Lump Sum</td>
</tr>
</tbody>
</table>
1110 Towing

1110.01 General
A. Description
This work includes towing of vehicles located in designated construction zones during the progress of the Work and as directed by the Engineer.

B. Submittal Requirements
None.

1110.02 Equipment Requirements
A. General
None.

1110.03 Construction Requirements
A. General
Towing shall be performed in accordance with Omaha Municipal Code Section 36-238. Vehicles eligible for towing shall be identified by the Engineer and shall be limited to vehicles that are upright and on wheels and conflicting with the current or proposed work activities. 'No Parking' signs shall have been in-place and maintained for a minimum of twenty-four (24) hours along the proposed street segment prior to towing a vehicle. The Contractor shall make reasonable attempts, including but not limited to, door-to-door investigation, to locate the owner and/operator of the vehicle prior to initiating the towing process.

Vehicles shall be towed using techniques that do not damage the towed vehicle or the roadway, adjacent structures, or other public property or assets. Vehicles shall be towed to a location designated by the Engineer at the time of towing, typically to an adjacent street beyond the proposed work area. Towed vehicles shall be positioned in a legal parking space within a public roadway in a manner that permits through traffic.

Immediately after towing a vehicle, the Contractor shall affix a notice to the windshield or other appropriate place on the vehicle, stating "This vehicle was parked in violation of Omaha Municipal Code Sections 36-177 through 36-180. It was moved to this location by Order of the City of Omaha Public Works Director.", or similar language as directed by the Engineer.

The City will not grant additional time or compensation for any resulting delays or loss of production because of failure to comply with the requirements of the Contract Documents, including posting of notices and identifying and towing vehicles.

B. Equipment
Towing equipment shall be equipped with a power winch, two-way radio, ten (10) pound dry fire extinguisher, motorcycle sling, dollies or flatbed equipment, and other modern towing and safety devices.

C. Insurance
A certificate of insurance shall be filed with the City of Omaha Public Works Department, Construction Division, prior to any towing work being performed. Failure to submit the certificate of insurance will prohibit any towing of vehicles in conflict with the Work.
D. Indemnification
The Contractor shall indemnify and save harmless the City, its officers, employees, and designated representatives, from all damages, claims, suits and actions of any description, for or resulting from injuries or damages received or sustained by any party or parties, arising out of any act, of said Contractor, or its agents, in the execution of the Work contained herein.

E. Towing Tickets
The Contractor shall deliver a towing ticket identifying the following information:

1. Date and time towing request was received.
2. Make, model, and license number of vehicle towed.
3. Locations vehicle was towed from and to.
4. Signature of an authorized City Representative with time and date work was performed.

1110.04 Acceptance
The Engineer shall observe the work to check for compliance with the Contract Documents.

1110.05 Measurement and Payment
The Engineer shall measure towing for payment by the hours that the equipment is required by the Engineer at the site, even though the actual operation of the equipment, at times, may be intermittent.

Hourly measurement shall be rounded to the nearest one-half (½) hour increment and commence with the start of travel directly to the jobsite, continue while actively towing vehicles on the jobsite, and end with departure of the towing vehicle from the project site. The time measured for a single tow shall not exceed ninety (90) minutes without written authorization from the Engineer. If a vehicle is moved after dispatch of but prior to arrival of the towing equipment, time expended during such period shall be measured and paid at the contract price for towing. Towing time expended without written authorization from the Engineer will not be measured for payment. Towing time incurred due to equipment breakdowns, including breakdowns attributed to the work performed, maintenance, or repairs, employee breaks or mealtimes, or any other event that temporarily or permanently removes the equipment from service will not be measured for payment. All breakdowns or malfunctions shall be reported to the Engineer immediately.

Payment shall be made under the following unless otherwise indicated in the Contract Documents. The Contract Price shall be full compensation for coordination, mobilization, demobilization, towing vehicles, winch fees, mechanical work, dolly fees, fuel, maintenance, and for furnishing all labor, materials, equipment, tools, and all incidentals necessary to complete the work.

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Towing</td>
<td>Hour</td>
</tr>
</tbody>
</table>