PROJECT
SPECIFICATIONS

Austin Community College District
Facilities and Construction
9101 Tuscany Way
Austin, Texas 78754

Round Rock Campus
4400 College Park Drive
Building 3000 Drainage Improvements

Consultant:
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AUSTIN COMMUNITY COLLEGE DISTRICT

ROUND ROCK CAMPUS – BUILDING 3000 DRAINAGE IMPROVEMENTS

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ITEM NO. 104
REMOVING PORTLAND CEMENT CONCRETE

104.1 Description
This item shall govern the demolition, removal and satisfactory disposal of existing Portland cement concrete, as classified, when encountered or at locations indicated on the Drawings.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text inch-pound units are given preference followed by SI units shown within parentheses.

104.2 Submittals
The submittal requirements of this specification item may include:
A. A permit when utility adjustments are made in the right-of-way, and
B. A plan for removal and deposition of all 'broken up' existing Portland cement (p.c.) concrete materials and debris.

104.3 Classification
Existing Portland cement concrete, when removed under this section, will be classified as follows:
1. Concrete Curb will include curb, curb and gutter and combinations thereof,
2. Concrete Slabs will include, but not be limited to, house slabs, patio slabs, porch slabs, concrete riprap and concrete pavement,
3. Sidewalks and Driveways will include concrete sidewalks and driveways,
4. Concrete Walls will include all walls, regardless of height, and wall footings,
5. Concrete Steps will include all steps and combinations of walls and steps,
6. Abandoned Foundations will include abandoned utility foundations,
7. Miscellaneous Concrete shall include all other concrete items, which are not identified in items 1 through 6 above.

104.4 Materials
Mortar shall conform to mortar specified in Standard Specification Item No. 403, “Concrete for Structures”.

104.5 Construction Methods
Prior to commencement of this work, all required erosion control and tree protection measures shall be in place. Existing utilities shall be located and protected.

The existing Portland cement concrete shall be broken up, removed in accordance with Item No. 101, "Preparing Right of Way" and disposed of at a permitted disposal site.
When it is specified that only a portion of the existing Portland cement (p.c.) concrete is to be removed and that the remaining p.c. concrete will continue to serve its purpose, special care shall be exercised to avoid damage to that portion which will remain in place. Unless otherwise approved by the Engineer, existing p.c. concrete shall be cut to the neat lines, that are indicated on the Drawings, by sawing with an appropriate type circular type circular concrete saw to a minimum depth of \( \frac{1}{2} \) inch (12.5 mm). Any reinforcing steel encountered shall be cut off 1 inch (25 mm) inside of p.c. concrete sawed line. Any existing p.c. concrete, which is damaged or destroyed beyond the neat lines so established, shall be replaced at the Contractor's expense. Remaining p.c. concrete shall be mortared to protect the reinforcing steel and provide a neat clean appearance.

When reinforcement is encountered during the removal of portions of existing structures to be modified, a minimum of 1 foot (300 mm) of steel length shall be cleaned of all old p.c. concrete and left in place to tie into the new construction where applicable. All unsuitable material shall be removed and replaced with approved material. All foundations, walls or other objectionable material shall be removed to a minimum depth of 18 inches (450 mm) below all structures and 12 inches (300 mm) below areas to be vegetated.

104.6 Measurement
The removal of p.c. concrete curb and p.c. concrete wall as prescribed above will be measured by the lineal foot (meter: 1 meter is equal to 3.281 feet) in its original position regardless of the dimensions or size. The removal of p.c. concrete slabs, p.c concrete sidewalks and driveways, as prescribed above, will be measured by the square foot (square meter: 1 square meter is equal to 10.764 square feet) in original position, regardless of the thickness and existence of reinforcing steel. Portland cement concrete steps removed will be measured per lineal foot (meter: 1 meter is equal to 3.281 feet) of each individual step tread including the bottom step. The removal of p.c. concrete foundations will be measured per each individual foundation. The removal of miscellaneous concrete will be measured per each.

104.7 Payment- **This section does not apply to this project.**
This item will generally be considered as subsidiary to specification items 110, "Street Excavation", 111, "Excavation", 120, "Channel Excavation" and 132, "Embankment". When included for payment the item will be paid for at the contract unit bid price(s) for "Remove P.C. Concrete Curb", "Remove P.C. Concrete Slab", "Remove P.C. Concrete Sidewalks and Driveways", "Remove P.C. Concrete Walls", "Remove P.C. Concrete Steps", "Remove P.C. Concrete Foundations" and "Remove Miscellaneous P.C. Concrete". The bid prices shall include full compensation for all Work herein specified, including the disposal of all material not required in the Work, the furnishing of all materials, equipment, tools, labor and incidentals necessary to complete the Work.
Payment will be made under one of the following:

- Remove P.C. Concrete Curb  Per Lineal foot.
- Remove P.C. Concrete Slab  Per Square foot.
- Remove P.C. Concrete Sidewalks and Driveways  Per Square foot
- Remove P.C. Concrete Wall  Per Lineal foot.
- Remove P.C. Concrete Steps  Per Lineal foot.
- Remove P.C. Concrete Foundations  Per Each.
- Remove Miscellaneous P.C. Concrete  Per Lump Sum.

End

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ITEM NO.110
STREET EXCAVATION

110.1 Description
This item shall govern: (1) the excavation and proper utilization or otherwise satisfactory disposal of all excavated material, of whatever character, within the right of way or other limits of the work indicated and (2) the construction, compaction, shaping and finishing of all earthwork on the entire project in accordance with the specification requirements herein outlined, in conformity with the required lines, grades and typical cross sections indicated on the Drawings or as approved by the Engineer. When not otherwise indicated, this item shall include the Work described in specification Item Nos. 101, "Preparing Right of Way", 102, "Clearing and Grubbing", 104, "Removing Portland Cement Concrete", 132, "Embankment", 201, "Subgrade Preparation" and 236, "Proof Rolling".

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text inch-pound units are given preference followed by SI units shown within parentheses.

110.2 Submittals
The submittal requirements of this specification item may include:
A. A permit when utility adjustments are made in the right-of-way,
B. A plan for removal and deposition of all 'Waste' materials, and
C. A Blasting Permit if blasting is required and allowed on the project.

110.3 Classification
All excavation shall be unclassified and shall include all materials encountered regardless of their nature or the manner in which they are removed.

110.4 Construction Methods
Prior to commencement of this work, all required erosion control and tree protection measures shall be in place. Existing utilities shall be located and protected or as indicated on the Drawings.

Construction equipment shall not be operated nor construction materials stockpiled under the canopies of trees, unless otherwise approved by the City Forestry Manager. Excavation or embankment materials shall not be placed within the drip line of trees until tree wells are constructed, as approved by the City Forestry Manager.

All street excavation shall be performed as specified herein and shall conform to the established alignment, grades and cross sections. The Contractor will be required to set blue-tops for the subgrade along centerlines, at quarter points and curb lines or edge of pavement at intervals not exceeding 50 feet (15.25 meters). Suitable excavated materials shall be utilized, insofar as practicable, in constructing any required embankments. The construction of all embankments shall conform to Item No. 132, "Embankment".
All earth cuts for base and/or pavement structure construction shall be scarified to a uniform depth of at least 6 inches (150 millimeters) below the required finished subgrade elevation for the entire roadbed width. The material shall be mixed, reshaped by blading, sprinkled and then rolled in accordance with Section 2 of Specification Item 132, "Embankment".

High PI materials (i.e. PI > 20 %) which exhibit a Plasticity Index (PI) greater by 5 % than the surrounding materials or any materials with a moisture content greater than 2% in excess of optimum moisture shall be classified as unsuitable and must be removed or manipulated to meet the above criteria before use.

Unsuitable excavated materials or excavation in excess of that needed for construction shall be known as "Waste" and shall become the property of the Contractor. Unsuitable material encountered below the subgrade elevation in roadway cuts, when declared "Waste" by the City Engineer, shall be replaced with material from the roadway excavation or with other suitable material as approved by the Engineer or designated representative. It shall become the Contractor's responsibility to dispose of this material off the limits of the right of way in an environmentally sound manner at a permitted disposal site.

110.5 Measurement
All accepted street excavation will be measured by either Method A or B as follows:

A. Method A
   Measurement of the volume of excavation in cubic yards (cubic meters: 1 cubic meter is equal to 1.308 cubic yards) by the average end areas. Cross sectional areas shall be computed from the existing ground surface to the established line of the subgrade over the limits of the right of way or other work limits shown on the Drawings, including parkway slopes and sidewalk areas.

B. Method B
   Measurement of the volume of excavation in cubic yards (cubic meters: 1 cubic meter is equal to 1.308 cubic yards), based upon the average end areas taken from pre-construction cross sections and planned grades. The planned quantities for street excavation will be used as the measurement for payment of this item.

110.6 Payment
This item will be paid for at the contract unit bid price for "Street Excavation", as provided under measurement Method A or B as included in the bid. The bid price shall include full compensation for all work herein specified, including subgrade preparation, unless specified otherwise, and the furnishing of all materials, equipment, tools, labor and incidentals necessary to complete the work.

Payment will be made under one of the following:

   Street Excavation Per Cubic yard.
   Street Excavation, Plan Quantity Per Cubic yard.
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ITEM NO. 130
BORROW

130.1 Description
This item shall govern required excavation, removal and proper utilization of materials secured from sources, selected by the Contractor and approved by the Engineer or designated representative. The compaction of embankments constructed from borrow as provided herein shall conform to the appropriate sections of Specification Item Nos. 132, "Embankment" and 236, “Proof Rolling”.

Borrow will be used only when indicated on the Drawings or directed by the Engineer or designated representative and shall only be acquired from sources approved by the City.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text inch-pound units are given preference followed by SI units shown within parentheses.

130.2 Submittals
The submittal requirements of this specification item may include:

A. Identification of Class, source and characteristics (P.I., linear shrinkage, etc.) of proposed borrow material, and
B. A plan for managing and maintaining borrow sites.

130.3 Materials
All authorized borrow shall conform to one of the following classes:

Class A (Select Borrow)
Class A Borrow material shall consist of suitable granular material, free from vegetation or other objectionable matter and reasonably free from lumps of earth. When tested by standard TxDOT laboratory methods Tex-105-E, Tex-106-E and Tex-107-E, the Class A Select Borrow, shall meet the following requirements:

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<td>The Plasticity Index shall not exceed</td>
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<td>The bar linear shrinkage shall not be less than</td>
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Class B (Borrow)
Class B Borrow material shall consist of suitable non swelling [i.e. soils with a plasticity index (P.I.) less than 20] earth material such as loam, clay or other such materials that will form a stable embankment.
Class C (Topsoil)
Class C Borrow material shall consist of approved soils, which shall be clean, friable and capable of supporting plant life. This material shall also be free of stones and all other debris.

130.4 Construction Methods
Prior to commencing this work, all required erosion control and environmental measures shall be in place. All suitable materials removed from excavations shall be used, insofar as practicable in the formation of embankments conforming to Specification Item No. 132, "Embankment", as otherwise indicated on the Drawings or as directed by the Engineer or designated representative. The completed work shall conform to the established alignment, grades and cross section as shown on the Drawings. The additional material necessary to complete the work described above shall be "Borrow" of the class specified.

The Contractor shall arrange for borrow from one of the following sources:
1. Existing borrow pit,
2. New borrow pit, or
3. Surplus excavated material from a site, with a site development permit.

The Contractor shall notify the Engineer 3 weeks prior to opening a pit or any other borrow source to allow necessary testing for approval of materials. All borrow sites shall comply with the requirements of the site development permit.

During construction, borrow sources shall be kept drained to permit final cross sections to be measured, when required.

Borrow sites shall be managed and maintained to minimize the impact of the appearance of the natural topographic features and at no time create a potential hazard to the public.

130.5 Measurement
Borrow will be measured by the cubic yard (cubic meters: 1 cubic meter is equal to 1.196 cubic yards) in its final position based upon the average end areas, calculated from pre-construction cross sections and plan grades. The plan quantities for Borrow or Topsoil will be used as the measurement for payment for this item.

130.6 Payment
All work performed as required herein and measured as provided under "Measurement" will be paid for at the unit bid price. The bid prices shall include full compensation for furnishing all labor; all materials; all royalty and freight involved; all hauling and delivering on the road; and all tools, equipment and incidentals necessary to complete the work. Payment will not be made for unauthorized work.
Payment will be made under one of the following:

- Class A (Select Borrow), Plan Quantity Per Cubic Yard.
- Class B (Borrow), Plan Quantity Per Cubic Yard.
- Class C (Topsoil), Plan Quantity Per Cubic Yard.

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<td>Tex-103-E</td>
<td>Determination of Moisture Content of Soil Materials</td>
</tr>
<tr>
<td>Tex-104-E</td>
<td>Determination of Liquid Limit of Soils</td>
</tr>
<tr>
<td>Tex-114-E</td>
<td>Laboratory Compaction Characteristics and Moisture-Density Relationship of Subgrade &amp; Embankment Soil</td>
</tr>
<tr>
<td>Tex-115-E</td>
<td>Field Method for Determination of In-Place Density of Soils and Base Materials</td>
</tr>
</tbody>
</table>
ITEM NO. 403
CONCRETE FOR STRUCTURES

403.1 Description
This item shall govern quality, storage, handling, proportioning and mixing of materials for Portland cement concrete construction of buildings, bridges, culverts, slabs, prestressed concrete and incidental appurtenances.

403.2 Materials
Concrete shall be composed of Portland cement or Portland cement and fly ash, water, aggregates (fine and coarse), and admixtures proportioned and mixed as hereinafter provided to achieve specified results.

(1) Cementitious Materials
Portland cement shall conform to ASTM C 150, Type I (General Purpose), Type II (General Purpose with Moderate Sulfate Resistance) and Type III (High Early Strength). Type I shall be used when none is specified. Type I and Type III shall not be used when Type II is specified. Type III may be used in lieu of Type I when the anticipated air temperature for the succeeding 12 hours will not exceed 60°F. All cement shall be of the same type and from the same source for a monolithic placement.

Portland cement manufactured in a cement kiln fueled by hazardous waste shall be considered as an approved product if the production facility is authorized to operate under regulation of the Texas Commission on Environmental Quality (TCEQ) and the U. S. Environmental Protection Agency (EPA). Supplier shall provide current TCEQ and EPA authorizations to operate the facility.

Fly ash (denoted by TxDOT designations Type A and Type B) may replace 20 to 35 percent of a mix design's Portland cement content by absolute volume. Fly ash shall not be used in mix designs with less than five (5) sacks of Portland cement per cubic yard unless specifically permitted by the contract Drawings or project manual. Fly Ash may be used in all other classes of concrete, except that Type B fly ash shall not be used with Type II cement. Fly ash shall conform to the requirements of Item 405, "Concrete Admixtures."

(2) Mixing Water
Water for use in concrete and for curing shall be potable water free of oils, acids, organic matter or other deleterious substances and shall not contain more than 1,000 parts per million of chlorides as Cl or sulfates as SO₄.

Contractor may request approval of water from other sources. Contractor shall arrange for samples to be taken from the source and tested at his expense. Water quality tests shall conform to AASHTO Method T 26 except where such methods are in conflict with provisions of this specification.
Coarse Aggregate

Coarse aggregate shall consist of durable particles of crushed or uncrushed gravel, crushed blast furnace slag, crushed stone or combinations thereof; free from frozen material or injurious amounts of salt, alkali, vegetable matter or other objectionable material either free or as an adherent coating. It shall not contain more than 0.25 percent by weight of clay lumps, nor more than 1.0 percent by weight of shale nor more than 5 percent by weight of laminated and/or friable particles when tested in accordance with TXDOT Test Method TEX-413-A. It shall have a wear of not more than 40 percent when tested in accordance with TXDOT Test Method TEX-410-A.

Unless otherwise indicated, coarse aggregate shall be subjected to 5 cycles of the soundness test conforming to TXDOT Test Method TEX-411-A. The loss shall not be greater than 12 percent when sodium sulfate is used or 18 percent when magnesium sulfate is used.

Coarse aggregate shall be washed. The Loss by Decantation (TXDOT Test Method TEX-406-A), plus allowable weight of clay lumps, shall not exceed 1 percent or value indicated on the plans or in the project manual, whichever is less. If material finer than the # 200 sieve is definitely established to be dust of fracture of aggregates made primarily from crushing of stone, essentially free from clay or shale as established by TXDOT Test Method TEX-406-A, the percent may be increased to 1.5.

The coarse aggregate factor may not be more than 0.82; however, when voids in the coarse aggregate exceed 48 percent of the total rodded volume, the coarse aggregate factor shall not exceed 0.85. The coarse aggregate factor may not be less than 0.68 except for a Class I machine extruded mix that shall not have a coarse aggregate factor not lower than 0.61.

When exposed aggregate surfaces are required, the coarse aggregate shall consist of particles with at least 40 percent crushed faces. Uncrushed gravel, polished aggregates and clear resilient coatings are not acceptable for exposed aggregate pedestrian surfaces (i.e. sidewalks, driveways, medians, islands, etc.). Grade 5 aggregates shall be used for exposed aggregate finishes.

When tested by approved methods, the coarse aggregate including combinations of aggregates when used, shall conform to the grading requirements shown in Table 1.
Table 1: Coarse Aggregate Gradation Chart (TEX 401-A, Percent Retained)

<table>
<thead>
<tr>
<th>Grade</th>
<th>Nom. Size</th>
<th>2-1/2&quot;</th>
<th>2&quot;</th>
<th>1 1/2&quot;</th>
<th>1&quot;</th>
<th>3/4</th>
<th>1/2&quot;</th>
<th>3/8&quot;</th>
<th>No. 4</th>
<th>No. 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2 1/2&quot;</td>
<td>0</td>
<td>0-20</td>
<td>15-50</td>
<td>60-80</td>
<td></td>
<td>95-100</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>1 1/2&quot;</td>
<td>0</td>
<td>0-5</td>
<td>30-65</td>
<td>70-90</td>
<td>95-100</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>1&quot;</td>
<td>0</td>
<td>0-5</td>
<td>10-40</td>
<td>40-75</td>
<td>95-100</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>1&quot;</td>
<td>0</td>
<td>0-5</td>
<td>40-75</td>
<td>90-100</td>
<td>95-100</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>3/4&quot;</td>
<td>0</td>
<td>0-10</td>
<td>45-80</td>
<td>90-100</td>
<td>95-100</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(4) Fine Aggregate

Fine aggregate shall consist of clean, hard, durable and uncoated particles of natural or manufactured sand or a combination thereof, with or without a mineral filler. It shall be free from frozen material or injurious amounts of salt, alkali, vegetable matter or other objectionable material and it shall not contain more than 0.5 percent by weight of clay lumps. When subjected to color test for organic impurities per TXDOT Test Method TEX-408-A, it shall not show a color darker than standard.

Acid insoluble residue of fine aggregate used in slab concrete subject to direct traffic shall not be less than 28 percent by weight when tested conforming to TXDOT Test Method TEX-612-J.

When tested by approved methods, the fine aggregate, including combinations of aggregates, when used, shall conform to the grading requirements shown in Table 2

Table 2: Fine Aggregate Gradation Chart (TEX 401-A, Percent Retained)

<table>
<thead>
<tr>
<th>3/8&quot;</th>
<th>No. 4</th>
<th>No. 8</th>
<th>No. 16</th>
<th>No. 30</th>
<th>No. 50</th>
<th>No. 100</th>
<th>No. 200</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0-5</td>
<td>0-20</td>
<td>15-50</td>
<td>35-75</td>
<td>65-90</td>
<td>90-100</td>
<td>97-100</td>
</tr>
</tbody>
</table>

Where sand equivalence is greater than 85, retainage on No. 50 sieve may be 65 to 94 percent. Where manufactured sand is used in lieu of natural sand, the percent retained on No. 200 sieve shall be 94 to 100. Sand equivalent per TXDOT Test Method TEX-203-F shall not be less than 80 nor less than otherwise indicated, whichever is greater. The fineness modulus will be determined by adding the percentages by weight retained on sieve Nos. 4, 8, 16, 30, 50 and 100 and dividing the sum of the six sieves by 100. For Class A and C concrete, the fineness modulus shall be between 2.30 and 3.10. For Class H concrete, the fineness modulus shall be between 2.40 and 2.90.
(5) Mineral Filler
Mineral filler shall consist of stone dust, clean crushed sand, approved fly ash or other approved inert material.

(6) Mortar (Grout)
Mortar for repair of concrete shall consist of 1 part cement, 2 parts finely graded sand and enough water to make the mixture plastic. When required to prevent color difference, white cement shall be added to produce color required. When required by the Engineer, an approved latex adhesive shall be added to the mortar.

(7) Admixtures
All admixtures shall comply with the requirements of ITEM 405 CONCRETE ADMIXTURES. Calcium chloride-based admixtures shall not be approved.

403.3 Storage of Cement and Fly Ash
Cement and fly ash shall be stored in separate and well ventilated, weatherproof buildings or approved bins which will protect the material from dampness or absorption of moisture. Storage facilities shall be easily accessible and each shipment of packaged cement shall be kept separated to provide for identification and inspection. Engineer may permit small quantities of sacked cement to be stored in the open for a maximum of 48 hours on a raised platform and under waterproof covering.

403.4 Storage of Aggregates
Aggregates shall be stockpiled in sizes to facilitate blending. If the aggregate is not stockpiled on a hard, non-contaminant base, the bottom 6-inch layer of the stockpile shall not be used without recleaning the aggregate. Where space is limited, stockpiles shall be separated by walls or other appropriate barriers. Aggregate shall be stockpiled and protected from the weather a minimum of 24 hours prior to use to minimize free moisture content. When stockpiles are too large to protect from the weather, accurate and continuous means acceptable to the Engineer shall be provided to monitor aggregate temperature and moisture. Aggregates shall be stockpiled and handled such that segregation and contamination are minimized.

403.5 Measurement of Materials
Water shall be accurately metered. Fine and coarse aggregates, mineral filler, bulk cement and fly ash shall be weighed separately. Allowances shall be made in the water volume and aggregate weights during batching for moisture content of aggregates and admixtures. Volumetric and weight measuring devices shall be acceptable to Engineer.

Batch weighing of sacked cement is not required; however, bags, individually and entire shipments, may not vary by more than 3 percent from the specified weight of 94 pounds per bag. The average bag weight of a shipment shall be determined by weighing 50 bags taken at random.
403.6 Mix Design
Contractor shall furnish a mix design acceptable to the Engineer for class of concrete specified. The mix shall be designed by a qualified commercial laboratory and signed/sealed by a Texas-registered Professional Engineer to conform with requirements contained herein, to ACI 211.1 or TXDOT Bulletin C-11 (and supplements thereto). Contractor shall perform, at his own expense, the work required to substantiate the design, including testing of strength specimens. Complete concrete design data shall be submitted to the Engineer for approval. The mix design will be valid for a period of one (1) year provided that there are no changes to the component materials.

At the end of one (1) year, a previously approved mix may be resubmitted for approval if it can be shown that no substantial change in the component materials has occurred. The resubmittal analysis must be reviewed, signed and sealed by a Texas-registered Professional Engineer. This resubmittal will include a reanalysis of specific gravity, absorption, fineness modulus, sand equivalent, soundness, wear and unit weights of the aggregates. Provided that the fineness modulus did not deviate by more than 0.20 or that the reportioned total mixing water, aggregate and cement (or cement plus fly ash) are within 1, 2, and 3 percent, respectively, of pre-approved quantities, a one-year extension on the approval of the mix may be granted by the Engineer. Updated cement, fly ash, and admixture certifications shall accompany the resubmittal.

Approved admixtures conforming to Item 405, "Concrete Admixtures" may be used with all classes of concrete at the option of the Contractor provided that specific requirements of the governing concrete structure specification are met. Water reducing and retarding agents shall be required for hot weather, large mass, and continuous slab placements. Air entraining agents may be used in all mixes but must be used in the classes indicated on Table 4. Unless approved by the Engineer, mix designs shall not exceed air contents for extreme exposure conditions as recommended by ACI 211.1 for the various aggregate grades.

403.7 Consistency and Quality of Concrete
Consistency and quality of concrete should allow efficient placement and completion of finishing operations before initial set. Retempering shall not be allowed. When field conditions are such that additional moisture is needed for final concrete surface finishing operation, required water shall be applied to surface by fog spray only and shall be held to a minimum. Concrete shall be workable, cohesive, possess satisfactory finishing qualities and of stiffest consistency that can be placed and vibrated into a homogeneous mass within slump requirements specified in Table 3. Excessive bleeding shall be avoided and in no case will it be permissible to expedite finishing and drying by sprinkling the surface with cement powder. No concrete will be permitted with a slump in excess of the maximums shown unless water-reducing admixtures have been previously approved. Slump values shall conform to TXDOT Test Method TEX-415-A.
Table 3: Slump Requirements

<table>
<thead>
<tr>
<th>Type of Construction</th>
<th>Slump, inches</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Maximum</td>
</tr>
<tr>
<td>Cased Drilled Shafts</td>
<td>4</td>
</tr>
<tr>
<td>Reinforced Foundation Caissons and Footings</td>
<td>3</td>
</tr>
<tr>
<td>Reinforced Footings and Substructure Walls</td>
<td>3</td>
</tr>
<tr>
<td>Uncased Drilled Shafts</td>
<td>6</td>
</tr>
<tr>
<td>Thin-walled Sections (9 inches or less)</td>
<td>5</td>
</tr>
<tr>
<td>Prestressed Concrete Members</td>
<td>5</td>
</tr>
<tr>
<td>Precast Drainage Structures</td>
<td>6</td>
</tr>
<tr>
<td>Wall Sections over 9 inches</td>
<td>4</td>
</tr>
<tr>
<td>Reinforced Building Slabs, Beams, Columns and Walls</td>
<td>4</td>
</tr>
<tr>
<td>Bridge Decks</td>
<td>4</td>
</tr>
<tr>
<td>Pavements, Fixed-form</td>
<td>3</td>
</tr>
<tr>
<td>Pavements, Slip-form</td>
<td>1-1/2</td>
</tr>
<tr>
<td>Sidewalks, Driveways and Slabs on Ground</td>
<td>4</td>
</tr>
<tr>
<td>Curb &amp; Gutter, Hand-vibrated</td>
<td>3</td>
</tr>
<tr>
<td>Curb &amp; Gutter, Hand-tamped or spaded</td>
<td>4</td>
</tr>
<tr>
<td>Curb &amp; Gutter, Slip-form/extrusion machine</td>
<td>2</td>
</tr>
<tr>
<td>Heavy Mass Construction</td>
<td>2</td>
</tr>
<tr>
<td>High Strength Concrete</td>
<td>4</td>
</tr>
<tr>
<td>Riprap and Other Miscellaneous Concrete</td>
<td>6</td>
</tr>
<tr>
<td>Under Water or Seal Concrete</td>
<td>6</td>
</tr>
</tbody>
</table>

During progress of the work, Owner’s/Developer’s testing laboratory shall cast test cylinders and/or beams as a check on compressive and/or flexural strength of concrete actually placed. Owner’s/Developer’s testing laboratory may also perform slump tests, entrained air tests and temperature checks to ensure compliance with specifications.

Proportioning of all material components shall be checked prior to discharging. Excluding mortar material for pre-coating of the mixer drum [403.8(2)] and adjustment for moisture content of admixtures and aggregates, material components shall fall within the range of $\pm 1\%$ for water, $\pm 2\%$ for aggregates, $\pm 3\%$ for cement, $-2\%$ for fly ash and within manufacturer recommended dosage rates for admixtures except that air entrainment shall be $\pm 1-1/2$ points of the mix design requirements.
Unless otherwise specified, concrete mix temperature shall not exceed 90° F except in mixes with high range water reducers where a maximum mix temperature of 100° F will be allowed. Cooling an otherwise acceptable mix by addition of water or ice will not be allowed.

Test beams or cylinders will be required for small placements such as manholes, inlets, culverts, wing walls, etc. Engineer may vary the number of tests to a minimum of 1 for each 25 cubic yards placed over a several day period.

Test beams or cylinders shall be required for each monolithic placement of bridge decks or superstructures, top slabs of direct traffic culverts, cased drilled shafts, structural beams and as otherwise directed by Engineer for design strength or early form removal. Test beams or cylinders made for early form removal or use of structure will be at Contractor's expense, except when required by Engineer.

A strength test shall be defined as the average of breaking strength of 2 cylinders or 2 beams as applicable. Specimens will be tested conforming to TXDOT Test Method TEX-418-A or TEX-420-A. If required strength or consistency of class of concrete being produced cannot be secured with minimum cementitious material specified or without exceeding maximum water/cementitious material ratio, Contractor will be required to furnish different aggregates, use a water reducing agent, an air entraining agent or increase cementitious material content in order to provide concrete meeting these specifications. Test specimens shall be cured using the same methods and under the same conditions as the concrete represented. Design strength beams and cylinders shall be cured conforming to TXDOT Bulletin C-11 (and supplements thereto).

When control of concrete quality is by 28-day compressive tests, job control will be by 7-day flexural tests. If the required 7-day strength is not secured with the quantity of cement specified in Table 4, changes in the mix design shall be made and resubmitted for approval.

<table>
<thead>
<tr>
<th>Class</th>
<th>Sk Cement Per CY</th>
<th>Minimum 28 Day psi</th>
<th>Minimum Beam 7 Day psi</th>
<th>*Maximum W/C Ratio</th>
<th>Coarse Agg. Number</th>
<th>**Air Ent.</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>5.0</td>
<td>3000</td>
<td>500</td>
<td>6.5</td>
<td>1,2,3,4,5</td>
<td>Yes</td>
</tr>
<tr>
<td>B</td>
<td>4.0</td>
<td>2000</td>
<td>300</td>
<td>8.0</td>
<td>2,3,4,5</td>
<td>No</td>
</tr>
<tr>
<td>C</td>
<td>6.0</td>
<td>3600</td>
<td>600</td>
<td>6.0</td>
<td>1,2,3,4,5</td>
<td>Yes</td>
</tr>
<tr>
<td>D</td>
<td>4.5</td>
<td>2500</td>
<td>425</td>
<td>7.5</td>
<td>2,3,4</td>
<td>No</td>
</tr>
<tr>
<td>H</td>
<td>6.0</td>
<td>As indicated</td>
<td>As Indicated</td>
<td>5.5</td>
<td>3,4</td>
<td>Yes</td>
</tr>
<tr>
<td>I</td>
<td>5.5</td>
<td>3500</td>
<td>575</td>
<td>6.2</td>
<td>2,3,4,5</td>
<td>Yes</td>
</tr>
<tr>
<td>J</td>
<td>2.0</td>
<td>800</td>
<td>N/A</td>
<td>N/A</td>
<td>2,3,4,5</td>
<td>No</td>
</tr>
<tr>
<td>S</td>
<td>6.0</td>
<td>3600</td>
<td>600</td>
<td>5.0</td>
<td>2,3,4,5</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Notes:
1. Grade 1 coarse aggregate may be used in massive foundations only (except case drilled shafts) with 4 inch minimum clear spacing between reinforcing steel.
2. When Type II cement is used in Class C or S concrete, the 7-day beam break requirement will be 550 psi; with Class A, 460 psi., minimum.
3. *The design water-cement ratio shall be appropriately adjusted for mixes with fly ash per ACI 211.1 or TXDOT C-11 (and supplements thereto), as applicable.
4. **Maximum air design contents for the five grades of coarse aggregate, unless otherwise approved by Engineer, are: 4.5% for Grade 1, 5.5% for Grade 2, and 6.0% for Grades 3, 4, and 5.

403.8 Mixing and Mixing Equipment
All equipment, tools and machinery used for hauling materials and performing any part of the work shall be maintained in such condition to insure completion of the work without excessive delays. Mixing shall be done in a mixer of approved type and size that will produce uniform distribution of material throughout the mass and shall be capable of producing concrete meeting requirements of ASTM C 94, Ready-mixed Concrete and these specifications. Mixing equipment shall be capable of producing sufficient concrete to provide required quantities. Entire contents of the drum shall be discharged before any materials are placed therein for a succeeding batch. Improperly mixed concrete shall not be placed in a structure. The mixer may be batched by either volumetric or weight sensing equipment and shall be equipped with a suitable timing device that will lock the discharging mechanism and signal when specified time of mixing has elapsed.

(1) Proportioning and Mixing Equipment
For all miscellaneous concrete placements, a mobile, continuous, volumetric mixer or a volumetric or weight batch mixer of the rotating paddle type may be used.

When approved by Engineer in writing or when specified for use, these mixers may be used for other types of concrete construction, including structural concrete, if the number of mixers furnished will supply the amount of concrete required for the particular operation in question.

These mixers shall be designed to receive all the concrete ingredients, including admixtures, required by the mix design in a continuous uniform rate and mix them to the required consistency before discharging. Mixers shall have adequate water supply and metering devices.

For continuous volumetric mixers, the materials delivered during a revolution of the driving mechanism or in a selected interval, will be considered a batch and the proportion of each ingredient will be calculated in the same manner as for a batch type plant.

Mixing time shall conform to recommendations of manufacturer of mixer unless otherwise directed by Engineer.
(2) Ready-mixed Concrete

Use of ready-mixed concrete will be permitted provided the batching plant and mixer trucks meet quality requirements specified herein. When ready-mixed concrete is used, additional mortar (1 sack cement, 3 parts sand and sufficient water) shall be added to each batch to coat the mixer drum. Ready-mixed concrete, batching plant and mixer truck operation shall include the following:

(a) A ticket system will be used that includes a copy for the Inspector. Ticket will have machine stamped time/date of concrete batch, weight of cement, fly ash, sand and aggregates; exact nomenclature and written quantities of admixtures and water. Any item missing or incomplete on ticket may be cause for rejection of concrete.

(b) Sufficient trucks will be available to support continuous placements. Contractor will satisfy Engineer that adequate standby trucks are available to support monolithic placement requirements.

(c) A portion of mixing water required by the mix design to produce the specified slump may be withheld and added at the job site, but only with permission of Engineer and under the Inspector's observation. When water is added under these conditions, it will be thoroughly mixed before any slump or strength samples are taken. Additional cement shall not be added at the job site to otherwise unacceptable mixes.

(d) A metal plate(s) shall be attached in a prominent place on each truck mixer plainly showing the various uses for which it was designed. The data shall include the drum's speed of rotation for mixing and for agitating and the capacity for complete mixing and/or agitating only. A copy of the manufacturer's design, showing dimensions of blades, shall be available for inspection at the plant at all times. Accumulations of hardened concrete shall be removed to the satisfaction of the Engineer or designated representative.

(e) The loading of the transit mixers shall not exceed capacity as shown on the manufacturer's plate attached to the mixer or 63 percent of the drum volume, whichever is the lesser volume. The loading of transit mixers to the extent of causing spill-out enroute to delivery will not be acceptable. Consistent spillage will be cause for disqualification of a supplier.

(f) Excess concrete remaining in the drum after delivery and wash water after delivery shall not be dumped on the project site unless approval of the dump location is first secured from the Engineer or designated representative.
(3) Hand-mixed Concrete

Hand mixing of concrete may be permitted for small placements or in case of an emergency and then only on authorization of the Engineer. Hand-mixed batches shall not exceed a 4 cubic foot batch in volume. Material volume ratios shall not be leaner than 1 part cement, 2 parts large aggregate, 1 part fine aggregate and enough water to produce a consistent mix with a slump not to exceed 4 inches. Admixtures shall not be used unless specifically approved by the Engineer.

403.9 Excavation, Placing of Concrete, Finishing, Curing and Backfill

Excavation, placing of concrete, finishing, curing and backfill shall conform to Item 401, "Structural Excavation and Backfill", and Item 410, "Concrete Structures".

403.10 Measurement

Where measurement of concrete for a structure is not provided by another governing pay item in the Project Manual, measurement shall be made under this specification in accordance with the following.

The quantities of concrete of the various classifications which constitute the completed and accepted structure or structures in place will be measured by the cubic yard, each, square foot, square yard or linear foot as indicated in the Project Manual. Measurement will be as follows:

(1) General

(a) Measurement based on dimensions shall be for the completed structure as measured in place. However, field-measured dimensions shall not exceed those indicated on the plans or as may have been directed by the Engineer in writing.

(b) No deductions shall be made for chamfers less than 2 inches in depth, embedded portions of structural steel, reinforcing steel, nuts, bolts, conduits less than 5 inches in diameter, pre/post tensioning tendons, keys, water stops, weep holes and expansion joints 2 inches or less in width.

(c) No measurement shall be made for concrete keys between adjoining beams or prestressed concrete planks.

(d) No measurement shall be made for fill concrete between the ends or adjoining prestressed concrete planks/box beams at bent caps or between the ends of prestressed concrete planks/box beams and abutment end walls.

(e) No measurement shall be made for inlet and junction box invert concrete.

(f) No measurement shall be made for any additional concrete required above the normal slab thickness for camber or crown.

(2) Plan Quantity. For those items measured for plan quantity payment, adequate calculations have been made. If no adjustment is required by Article 403.11, additional measurements or calculations will not be required or made.
(3) Measured in Place. For those items not measured for Plan Quantity payment, measurement will be made in place, subject to the requirements of Article 403.10(1)(a) above.

403.11 Payment

The work performed and materials furnished as prescribed by this item and measured in accordance with the applicable provisions of "Measurement" above will be paid for as follows.

The quantity to be paid for will be that quantity shown on the contract plans and/or in the Project Manual, regardless of errors in calculations, except as may be modified by the following.

Plan Quantities will be adjusted:

(1) When a complete structure element has been erroneously included or omitted from the plans, the quantity shown on the plans for that element will be added to or deducted from the plan quantity and included for payment. A complete structure element will be the smallest portion of a total structure for which a quantity is included on the plans. Quantities revised in this manner will not be subject to the provisions contained elsewhere in the contract.

(2) When the plan quantity for a complete structure element is in error by 5 percent or more, a recalculation will be made and the corrected quantity included for payment. Quantities revised in this manner will not be subject to the provisions contained elsewhere in the contract.

(3) When quantities are revised by a change in design, the "plan quantity" will be increased or decreased by the amount involved in the design change. Quantities revised in this manner will be subject to the provisions contained elsewhere in the contract.

The party to the contract requesting the adjustment shall present to the other, a copy of the description and location, together with calculations of the quantity for the structure element involved. When this quantity is certified correct by the Engineer, it will become the revised plan quantity.

Payment for increased or decreased costs due to a change in design on those items measured as "Cubic Yard", "Each", "Square Foot", "Square Yard" or "Linear Foot" will be determined by Change Order. Quantities revised in this manner will be subject to the provisions contained elsewhere in the contract.

The unit prices bid for the various classes of concrete shown shall be full compensation for furnishing, hauling, and mixing all concrete material; placing, finishing and curing all concrete; all grouting and pointing; furnishing and placing drains; furnishing and placing metal flashing strips; furnishing and placing expansion joint material required by this item; and for all forms and false work, labor, tools, equipment and incidentals necessary to complete the work.

(Structure or Structural Component) - Per (Unit Measure).

End
All mixes with air entrainment shall have a minimum relative durability factor of 80 in accordance with ASTM C 260. Dosage of air entrainment admixtures may be adjusted by the Contractor to stay within the specified tolerances for air entrainment of ITEM 403 CONCRETE FOR STRUCTURES.

405.5 Measurement and Payment
The requirements of this specifications shall not be measured and paid for directly, but shall be subsidiary to the various bid items in the project manual.

End
Ref.: 403
ITEM NO. 405
CONCRETE ADMIXTURES

405.1 Description
This item shall govern material requirements of admixtures for Portland cement concrete.

405.2 Materials
All admixture submittals must be approved by the Engineer. No admixture shall be chloride-based or have chloride(s) added in the manufacturing process. Admixtures must be pretested by the Texas Department of Transportation (TXDOT) Materials and Tests Engineer and be included in the State's current approved admixture list. All admixtures must retain an approved status through the duration of a mix design's one-year approval period.

1) Air Entraining Admixture: An "Air Entraining Admixture" is defined as a material which, when added to a concrete mixture in the proper quantity, will entrain uniformly dispersed microscopic air bubbles in the concrete mix. The admixture shall meet the requirements of ASTM Designation: C 260 modified as follows:
   (a) The cement used in any series of test shall be either the cement proposed for the specific work or a "reference" Type I cement from one mill.
   (b) The air entraining admixture used in the reference concrete shall be Neutralized Vinsol Resin.

2) Water-reducing Admixture: A "Water-reducing Admixture" is defined as a material which, when added to a concrete mixture in the correct quantity, will reduce the quantity of mixing water required to produce concrete of a given consistency and required strength. This admixture shall conform to ASTM C 494, Type A.

3) Accelerating Admixture: An "Accelerating Admixture" is defined as an admixture that accelerates the setting time and the early strength development of concrete. This admixture shall conform to ASTM C 494, Type C. The accelerating admixture will contain no chlorides.

4) Water-reducing, Retarding Admixture: A "Water-reducing, Retarding Admixture" is defined as a material which, when added to a concrete mixture in the correct quantity, will reduce the quantity of mixing water required to produce concrete of a given consistency and retard the initial set of the concrete. This admixture shall conform to ASTM C 494, Type D.

5) High-range Water Reducing Admixtures: A "High-range Water Reducing Admixture", referred to as a super plasticizer, is defined as a synthetic polymer material which, when added to a low slump concrete mixture increases the slump without adversely affecting segregation, impermeability or durability of the mix. This admixture shall conform to ASTM C 494, Type F or G.
Fly Ash: Fly ash used in Portland cement concrete as a substitute for Portland cement or as a mineral filler shall comply with TXDOT Materials Specification D-9-8900 and be listed on TXDOT’s current list of approved fly ash sources. Fly ash obtained from a source using a process fueled by hazardous waste (30 Texas Administrative Code, Section 335.1) shall be prohibited. This applies to any other specification concerning the use of fly ash. Contractor shall maintain a record of source for each batch. Supplier shall certify that no hazardous waste is used in the fuel mix or raw materials.

405.3 Certification and Product Information
The Contractor shall submit the name of the admixture proposed and manufacturer’s certification that the selected admixtures meet the requirements of this item and of ASTM C 260 and C 494 as applicable. Admixtures for a mix design shall be of the same brand. If more than one admixture is proposed in the concrete mix, a statement of compatibility of components shall accompany certification. Manufacturer’s product literature shall specify when in the batching/mixing operation the admixture must be added.

The Engineer may request additional information such as infrared spectrophotometry scan, solids content, pH value, etc., for further consideration. Any unreported changes in formulation discovered by any of the tests prescribed herein may be cause to permanently bar the manufacturer from furnishing admixtures for Owner's/Developer's work.

405.4 Construction Use of Admixtures
All admixtures used shall be liquid except high-range water reducers which may be a powder. Liquid admixtures shall be agitated as needed to prevent separation or sedimentation of solids; however, air agitation of Neutralized Vinsol Resin will not be allowed.

No admixture shall be dispensed on dry aggregates. Admixtures shall be dispensed at the batching site separately, but at the same time as the mixing water. Only high range water reducers may be introduced into the mix at the job site.

When other admixtures are used with fly ash, the amount of the other admixture to be used shall be based on the amount of Portland cement only and not the amount of Portland cement and fly ash.

When high-range water reducers are to be added at the job site, transit mixers shall be used. Admixture manufacturer literature shall indicate recommended mixing methods and time for the specific equipment and mix design used. The transit mix equipment shall not be loaded in excess of 63 percent of its rated capacity to ensure proper mixing of the admixture at the site. If during discharging of concrete a change in slump in excess of 30% is noted, the remaining concrete shall be rejected unless prior approval was given by the Engineer to retemper a load with a second charge of admixture. Retempering with water shall not be allowed.

Accelerating admixtures will not be permitted in combination with Type II cement.
All mixes with air entrainment shall have a minimum relative durability factor of 80 in accordance with ASTM C 260. Dosage of air entrainment admixtures may be adjusted by the Contractor to stay within the specified tolerances for air entrainment of ITEM 403 CONCRETE FOR STRUCTURES.

405.5 Measurement and Payment
The requirements of this specifications shall not be measured and paid for directly, but shall be subsidiary to the various bid items in the project manual.

End

Ref.: 403
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ITEM NO. 406
REINFORCING STEEL

406.1 Description
This item shall consist of the furnishing and placing of reinforcing steel, deformed and smooth, of the size and quantity indicated and in accordance with these specifications.

406.2 Materials
(1) Bars
Bar reinforcement shall be deformed and shall conform to ASTM A 615, A 616, Grades 40, 60 or 75 and shall be open-hearth, basic oxygen or electric furnace new billet steel, unless otherwise indicated. Large diameter new billet steel (Nos. 14 and 18), Grade 75, will be permitted for straight bars only.

Where bending of bar sizes No. 14 or No. 18 of Grades 40 or 60 is required, bend testing shall be performed on representative specimens as described for smaller bars in the applicable ASTM specification. The required bend shall be 90 degrees at a minimum temperature of 60 F around a pin having a diameter of 10 times the nominal diameter of the bar and shall be free of cracking.

Spiral reinforcement shall be either smooth or deformed bars or wire of the minimum diameter indicated. Bars for spiral reinforcement shall comply with ASTM A 675, A 615 or A 617. Wire shall comply with ASTM A 82. The minimum yield strength for spiral reinforcement shall be 40,000 psi.

In cases where the provisions of this item are in conflict with the provisions of the ASTM Designation to which reference is made, the provisions of this item shall govern.

Report of chemical analysis showing the percentages of carbon, manganese, phosphorus and sulphur will be required for all reinforcing steel when it is to be welded, except for drill shafts. No tack welding will be allowed. All welding shall conform to the requirements of AWS D-1-72.

The nominal size and area and the theoretical weight (lbs.) of reinforcing steel bars covered by these specifications are as follows:

<table>
<thead>
<tr>
<th>Bar Size Number</th>
<th>Nominal Diameter Inches</th>
<th>Nominal Area Square Inches</th>
<th>Weight per Linear Foot</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>0.250</td>
<td>0.05</td>
<td>0.167</td>
</tr>
<tr>
<td>3</td>
<td>0.375</td>
<td>0.11</td>
<td>0.376</td>
</tr>
<tr>
<td>4</td>
<td>0.500</td>
<td>0.20</td>
<td>0.668</td>
</tr>
<tr>
<td>5</td>
<td>0.625</td>
<td>0.31</td>
<td>1.043</td>
</tr>
<tr>
<td>6</td>
<td>0.750</td>
<td>0.44</td>
<td>1.502</td>
</tr>
<tr>
<td>7</td>
<td>0.875</td>
<td>0.60</td>
<td>2.044</td>
</tr>
</tbody>
</table>
Bar Size Number | Nominal Diameter Inches | Nominal Area Square Inches | Weight per Linear Foot
--- | --- | --- | ---
8 | 1.000 | 0.79 | 2.670
9 | 1.128 | 1.00 | 3.400
10 | 1.270 | 1.27 | 4.303
11 | 1.410 | 1.56 | 5.313
14 | 1.693 | 2.25 | 7.65
18 | 2.257 | 4.00 | 13.60

Smooth bars, larger than No. 4, may be steel conforming to the above or may be furnished in any steel that meets the physical requirements of ASTM A 36.

Smooth, round bars shall be designated by size number through No. 4. Smooth bars above No. 4 shall be designated by diameter in inches.

(2) Welded Wire Fabric

Wire for fabric reinforcement shall be cold-drawn from rods hot-rolled from open-hearth, basic oxygen or electric furnace billet. Wire shall conform to the requirements of the Standard Specifications for Cold-Drawn Steel Wire for Concrete Reinforcement, ASTM A 82 or A 496. Wire fabric, when used as reinforcement, shall conform to ASTM A 185 or A 497.

When wire is ordered by size numbers, the following relation between size number, diameter in inches and area shall apply unless otherwise indicated:

<table>
<thead>
<tr>
<th>Size W Number</th>
<th>Nominal Diameter (inch)</th>
<th>Nominal Area square inches</th>
</tr>
</thead>
<tbody>
<tr>
<td>31</td>
<td>0.628</td>
<td>0.310</td>
</tr>
<tr>
<td>30</td>
<td>0.618</td>
<td>0.300</td>
</tr>
<tr>
<td>28</td>
<td>0.597</td>
<td>0.280</td>
</tr>
<tr>
<td>26</td>
<td>0.575</td>
<td>0.260</td>
</tr>
<tr>
<td>24</td>
<td>0.553</td>
<td>0.240</td>
</tr>
<tr>
<td>22</td>
<td>0.529</td>
<td>0.220</td>
</tr>
<tr>
<td>20</td>
<td>0.505</td>
<td>0.200</td>
</tr>
<tr>
<td>18</td>
<td>0.479</td>
<td>0.180</td>
</tr>
<tr>
<td>16</td>
<td>0.451</td>
<td>0.160</td>
</tr>
<tr>
<td>Size W Number</td>
<td>Nominal Diameter (inch)</td>
<td>Nominal Area square inches</td>
</tr>
<tr>
<td>---------------</td>
<td>-------------------------</td>
<td>---------------------------</td>
</tr>
<tr>
<td>14</td>
<td>0.422</td>
<td>0.140</td>
</tr>
<tr>
<td>12</td>
<td>0.391</td>
<td>0.120</td>
</tr>
<tr>
<td>10</td>
<td>0.357</td>
<td>0.100</td>
</tr>
<tr>
<td>8</td>
<td>0.319</td>
<td>0.080</td>
</tr>
<tr>
<td>7</td>
<td>0.299</td>
<td>0.070</td>
</tr>
<tr>
<td>6</td>
<td>0.276</td>
<td>0.060</td>
</tr>
<tr>
<td>5.5</td>
<td>0.265</td>
<td>0.055</td>
</tr>
<tr>
<td>5</td>
<td>0.252</td>
<td>0.050</td>
</tr>
<tr>
<td>4.5</td>
<td>0.239</td>
<td>0.045</td>
</tr>
<tr>
<td>4</td>
<td>0.226</td>
<td>0.040</td>
</tr>
<tr>
<td>3.5</td>
<td>0.211</td>
<td>0.035</td>
</tr>
<tr>
<td>3</td>
<td>0.195</td>
<td>0.030</td>
</tr>
<tr>
<td>2.5</td>
<td>0.178</td>
<td>0.025</td>
</tr>
<tr>
<td>2</td>
<td>0.160</td>
<td>0.020</td>
</tr>
<tr>
<td>1.5</td>
<td>0.138</td>
<td>0.015</td>
</tr>
<tr>
<td>1.2</td>
<td>0.124</td>
<td>0.012</td>
</tr>
<tr>
<td>1</td>
<td>0.113</td>
<td>0.010</td>
</tr>
<tr>
<td>0.5</td>
<td>0.080</td>
<td>0.005</td>
</tr>
</tbody>
</table>

Where deformed wire is required, the size number shall be preceded by D and for smooth wire the prefix W shall be shown.

(3) **Chairs and Supports**

Chairs and Supports shall be steel, precast mortar or concrete blocks cast in molds meeting the approval of the Engineer/Architect of sufficient strength to position the reinforcement as indicated when supporting the dead load of the reinforcement, the weight of the workers placing concrete and the weight of the concrete bearing on the steel. Chairs shall be plastic coated when indicated.
### Chair Types and Applicable Uses

<table>
<thead>
<tr>
<th>Structural or Architectural Elements (columns, beams, walls, slabs) exposed to weather, not subjected to sand blasting, water blasting or grinding.</th>
<th>Galvanized steel or steel chairs with plastic coated feet.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structural or Architectural Elements exposed to weather and subject to sand blasting, water blasting or grinding.</td>
<td>Stainless steel chairs.</td>
</tr>
<tr>
<td>Structural or Architectural Elements not exposed to weather or corrosive conditions.</td>
<td>Uncoated steel chairs</td>
</tr>
<tr>
<td>Slabs and grade beams cast on grade.</td>
<td>Steel chairs with a base with 9 inch² minimum area or sufficient area to prevent the chair from sinking into fill or subgrade. Precast mortar or concrete blocks meeting the requirements of this item may be used.</td>
</tr>
</tbody>
</table>

#### 406.3 Bending

The reinforcement shall be bent cold, true to the shapes indicated. Bending shall preferably be done in the shop. Irregularities in bending shall be cause for rejection.

Unless otherwise indicated, the inside diameter of bar bends, in terms of the nominal bar diameter \(d\), shall be as follows:

- Bends of 90 degrees and greater in stirrups, ties and other secondary bars that enclose another bar in the bend shall be:

<table>
<thead>
<tr>
<th>Bar Number</th>
<th>Grade 40</th>
<th>Grade 60</th>
</tr>
</thead>
<tbody>
<tr>
<td>3, 4, 5</td>
<td>3d</td>
<td>4d</td>
</tr>
<tr>
<td>6, 7, 8</td>
<td>4d</td>
<td>5d</td>
</tr>
</tbody>
</table>

- All bends in main bars and in secondary bars not covered above shall be:

<table>
<thead>
<tr>
<th>Bar Number</th>
<th>Grade 40</th>
<th>Grade 60</th>
<th>Grade 75</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 thru 8</td>
<td>6d</td>
<td>6d</td>
<td>—</td>
</tr>
<tr>
<td>9, 10</td>
<td>8d</td>
<td>8d</td>
<td>—</td>
</tr>
<tr>
<td>11</td>
<td>8d</td>
<td>8d</td>
<td>8d</td>
</tr>
<tr>
<td>14, 18</td>
<td>10d</td>
<td>10d</td>
<td>—</td>
</tr>
</tbody>
</table>
406.4 Tolerances
Fabricating tolerances for bars, from plan dimensions shall not be greater than shown in Figure 1 under 440.4 “Tolerances” contained in TxDot Standard Specification, Item No. 440, “Reinforcing Steel”.

406.5 Storing
Steel reinforcement shall be stored above the surface of the ground upon platforms, skids or other supports and shall be protected as far as practicable from mechanical injury and surface deterioration caused by exposure to conditions producing rust. When placed in the work, reinforcement shall be free from dirt, paint, grease, oil or other foreign materials. Reinforcement shall be free from injurious defects such as cracks and laminations. Rust, surface seams, surface irregularities or mill scale will not be cause for rejection, provided the minimum dimensions, cross sectional area and tensile properties of a hand wire brushed specimen meets the physical requirements for the size and grade of steel indicated.

406.6 Splices
No splicing of bars, except when indicated or specified herein, will be permitted without written approval of the Engineer. No substitution of bars will be allowed without the approval of the Engineer. Any splicing of substituted bars shall conform to Table 1.

Splices not indicated will be permitted in slabs not more than 15 inches in thickness, columns, walls and parapets, but not included for measurement, subject to the following:

Splices will not be permitted in bars 30 feet or less in plan length. For bars exceeding 30 feet in plan length, the distance center to center of splices shall not be less than 30 feet minus 1 splice length, with no more than 1 individual bar length less than 10 feet. Splices not indicated, but permitted hereby, shall conform to Table 1. The specified concrete cover shall be maintained at such splices and the bars placed in contact and securely tied together.
Table 1
Minimum Lap Requirements

<table>
<thead>
<tr>
<th>Bar Number</th>
<th>Grade 40</th>
<th>Grade 60</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>1 foot 0 inches</td>
<td>1 foot 0 inches</td>
</tr>
<tr>
<td>4</td>
<td>1 foot 2 inches</td>
<td>1 foot 9 inches</td>
</tr>
<tr>
<td>5</td>
<td>1 foot 5 inches</td>
<td>2 feet 2 inches</td>
</tr>
<tr>
<td>6</td>
<td>1 foot 9 inches</td>
<td>2 feet 7 inches</td>
</tr>
<tr>
<td>7</td>
<td>2 feet 4 inches</td>
<td>3 feet 5 inches</td>
</tr>
<tr>
<td>No. 8</td>
<td>3 feet 0 inches</td>
<td>4 feet 6 inches</td>
</tr>
<tr>
<td>No. 9</td>
<td>3 feet 10 inches</td>
<td>5 feet 8 inches</td>
</tr>
<tr>
<td>No. 10</td>
<td>4 feet 10 inches</td>
<td>7 feet 3 inches</td>
</tr>
<tr>
<td>No. 11</td>
<td>5 feet 11 inches</td>
<td>8 feet 11 inches</td>
</tr>
</tbody>
</table>

Spiral steel shall be lapped a minimum of 1 turn. Bar No. 14 and No. 18 may not be lapped.

Welding of reinforcing bars may be used only where indicated or as permitted herein. All welding operations, processes, equipment, materials, workmanship and inspection shall conform to the requirements indicated. All splices shall be of such dimension and character as to develop the full strength of the bar being spliced.

End preparation for butt welding reinforcing bars shall be done in the field, except Bar No. 6 and larger shall be done in the shop. Delivered bars shall be of sufficient length to permit this practice.

For box culvert extensions with less than 1 foot of fill, the existing longitudinal bars shall have a lap with the new bars as shown in Table 1. For box culvert extensions with more than 1 foot of fill, a minimum lap of 6 inches will be required.

Unless otherwise indicated, dowel bars transferring tensile stresses shall have a minimum embedment equal to the minimum lap requirements shown in Table 1. Shear transfer dowels shall have a minimum embedment of 12 inches.

406.7 Placing
Reinforcement shall be placed as near as possible in the position indicated. Unless otherwise indicated, dimensions shown for reinforcement are to the centers of the bars. In the plane of the steel parallel to the nearest surface of concrete, bars shall not vary from plan placement by more than 1/12 of the spacing between bars. In the plane of the steel perpendicular to the nearest surface of concrete, bars shall not vary from plan placement by more than ¼ inch. Cover of concrete to the nearest surface of steel shall be as follows:
<table>
<thead>
<tr>
<th>Condition</th>
<th>Minimum Cover, Inches</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Concrete cast against and permanently exposed to earth</td>
<td>3</td>
</tr>
<tr>
<td>(b) Concrete exposed to earth or weather:</td>
<td></td>
</tr>
<tr>
<td>Bar No. 6 through 18 bars</td>
<td>2</td>
</tr>
<tr>
<td>Bar No. 5, W31 or D31 wire and smaller</td>
<td>1½</td>
</tr>
<tr>
<td>(c) Concrete not exposed to weather or in contact with ground:</td>
<td></td>
</tr>
<tr>
<td>Slabs, walls, joists:</td>
<td></td>
</tr>
<tr>
<td>Bar No. 14 and 18</td>
<td>1½</td>
</tr>
<tr>
<td>Bar No. 11 and smaller</td>
<td>1</td>
</tr>
<tr>
<td>Beams, columns:</td>
<td></td>
</tr>
<tr>
<td>Primary reinforcement, ties, stirrups, spirals</td>
<td>1½</td>
</tr>
<tr>
<td>Shells, folded plate members:</td>
<td></td>
</tr>
<tr>
<td>Bar No. 6 and larger</td>
<td>1</td>
</tr>
<tr>
<td>Bar No. 5, W31 or D31 wire, and smaller</td>
<td>1</td>
</tr>
</tbody>
</table>

Vertical stirrups shall always pass around the main tension members and be attached securely thereto. The reinforcing steel shall be spaced its required distance from the form surface by means of approved galvanized metal spacers, metal spacers with plastic coated tips, stainless steel spacers, plastic spacers or approved precast mortar or concrete blocks. For approval of plastic spacers on a project, representative samples of the plastic shall show no visible indications of deterioration after immersion in a 5 percent solution of sodium hydroxide for 120 hours.

All reinforcing steel shall be tied at all intersections, except that where spacing is less than 1 foot in each direction, alternate intersections only need be tied. For reinforcing steel cages for other structural members, the steel shall be tied at enough intersections to provide a rigid cage of steel. Mats of wire fabric shall overlap each other 1 full space as a minimum to maintain a uniform strength and shall be tied at the ends and edges.

Where prefabricated deformed wire mats are specified or if the Contractor requests, welded wire fabric may be substituted for a comparable area of steel reinforcing bar plan, subject to the approval of the Engineer.

A suitable tie wire shall be provided in each block, to be used for anchoring to the steel. Except in unusual cases and when specifically authorized by the Engineer, the size of the surface to be placed adjacent to the forms shall not exceed 2½ inches square or the equivalent thereof in cases where circular or rectangular areas are provided. Blocks shall be cast accurately to the thickness required and the surface to be placed adjacent to the forms shall be a true plane, free of surface imperfections.
Reinforcement shall be supported and tied in such a manner that a sufficiently rigid cage of steel is provided. If the cage is not adequately supported to resist settlement or floating upward of the steel, overturning of truss bars or movement in any direction during concrete placement, permission to continue concrete placement will be withheld until corrective measures are taken. Sufficient measurements shall be made during concrete placement to insure compliance with the above.

No concrete shall be deposited until the Engineer has reviewed the placement of the reinforcing steel and all mortar, mud, dirt, etc, shall be cleaned from the reinforcement, forms, workers' boots and tools.

406.8 Measurement
The measurement of quantities of reinforcement furnished and placed will be based on the calculated weight of the steel actually placed as indicated, with no allowance made for added bar lengths for splices requested by the Contractor nor for extra steel used when bars larger than those indicated or with a higher grade of steel are substituted with the permission of the Engineer. Tie wires and supporting devices will not be included in the calculated weights. The calculated weight of bar reinforcement will be determined using the theoretical bar weight set forth in this item.

Measurement required by a change in design will be computed as described above for the actual steel required to complete the work.

406.9 Payment
This item shall be paid for at the unit price bid per pound of "Reinforcing Steel", which price shall be full compensation for furnishing, bending, fabricating, welding and placing reinforcement, for all clips, blocks, metal spacers, ties, chairs, wire or other materials used for fastening reinforcement in place and for all tools, labor, equipment and incidentals necessary to complete the work.

Reinforcement in items specifically including the reinforcement shall not be paid for directly, but shall be included in the unit price bid for the items of construction in which the reinforcing steel is used.

Payment, when included as a contract pay item, will be made under:

Reinforcing Steel - Per Pound.

End
ITEM NO. 408
CONCRETE JOINT MATERIALS

408.1 Description
This item shall govern for the furnishing and placing of all longitudinal, contraction and expansion joint material in concrete work as herein specified in the various items of these specifications as indicated or as directed by the Engineer.

408.2 Materials
(1) Preformed Asphalt Board
Preformed asphalt board formed from cane or other suitable fibers of a cellular nature securely bound together and uniformly impregnated with a suitable asphalitic binder and meeting the requirements of the Standard Specifications for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction, ASTM D 1751.

(2) Preformed Nonbituminous Fiber Material
Preformed nonbituminous fiber material shall meet the requirements of the Standard Specifications for the Preformed Expansion Joint Filler for Concrete Paving and Structural Construction, ASTM D 1751, except that the requirements pertaining to bitumen content, density and water absorption shall be voided.

(3) Boards
Boards obtained from Redwood timber, of sound heartwood, free from sapwood, knots, clustered birdseye, checks and splits. Occasional sound or hollow birdseye, when not in clusters, will be permitted provided the board is free from any other defects that will impair its usefulness as a joint filler.

(4) Joint Sealer (Concrete Pavement)
This material shall be a one part low modulus silicone especially designed to cure at ambient temperatures by reacting with moisture in the air and shall have the following properties:

<table>
<thead>
<tr>
<th>As Supplied</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Color</td>
<td>Gray</td>
</tr>
<tr>
<td>Flow, MIL-2-8802D Sec. 4.8.4</td>
<td>0.2 maximum</td>
</tr>
<tr>
<td>Working Time, minutes</td>
<td>10</td>
</tr>
<tr>
<td>Tack-Free Time at 77 F± 2F Min. MIL-2-8802D Sec. 4.8.7</td>
<td>60</td>
</tr>
<tr>
<td>Cure time, at 77F (25C), days</td>
<td>7-14</td>
</tr>
<tr>
<td>Full Adhesion, days</td>
<td>14-21</td>
</tr>
</tbody>
</table>
The joint sealer shall adhere to the sides of the concrete joint or crack and shall be an effective seal against infiltration of water and incompressibles. The material shall not crack or break when exposed to low temperature.

(5) Backer Rod

Backer Rod shall be expanded closed cell polyethylene foam compatible with sealant. No bond or reaction shall occur between rod and sealant. Backer Rod shall be of sufficient width to be in compression after placement and shall be used with joint sealer.

(6) Joint Sealing Material

Joint Sealing Material for other than pavement use may be a two-component, synthetic polymer or cold-pourable, self leveling type meeting the following requirements:

The material shall adhere to the sides of the concrete joint or crack and shall form an effective seal against infiltration of water and incompressibles. The material shall not crack or break when exposed to low temperatures. Curing is to be by polymerization and not by evaporation of solvent or fluxing of harder particles. It shall cure sufficiently at an average temperature of 77±3F so as not to pick up under wheels of traffic in a maximum of 3 hours.

Performance Requirements:

When tested in accordance with Test Method Tex-525-C, the joint sealing material shall meet the above curing times and the requirements as follows:

It shall be of such consistency that it can be mixed and poured or mixed and extruded into joints at temperatures above 60 F.
<table>
<thead>
<tr>
<th>Test Description</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Penetration 77F.150 gm. Cone, 5 sec., max.-cm</td>
<td>0.90</td>
</tr>
<tr>
<td>Bond and Extension 75%, 0F, 5 cycles: Dry Concrete Blocks</td>
<td>Pass</td>
</tr>
<tr>
<td>Wet Concrete Blocks</td>
<td>Pass</td>
</tr>
<tr>
<td>Steel Blocks (Primed if specified by manufacturer)</td>
<td>Pass</td>
</tr>
<tr>
<td>Flow at 200 F</td>
<td>None</td>
</tr>
<tr>
<td>Water content % by weight, max.</td>
<td>5.0</td>
</tr>
<tr>
<td>Resilience:</td>
<td></td>
</tr>
<tr>
<td>Original sample min. % (cured)</td>
<td>50</td>
</tr>
<tr>
<td>Oven-aged at 158 F. min. %</td>
<td>50</td>
</tr>
<tr>
<td>For Class 1-a material only</td>
<td></td>
</tr>
<tr>
<td>Cold Flow (10 min.)</td>
<td>None</td>
</tr>
</tbody>
</table>

408.3 Construction Methods
The Contractor shall install "Concrete Joint Materials" which will function as a compatible system. Joint sealer shall not be placed where a bond breaker is present.

Asphalt, Redwood board or other materials used shall extend the full depth of the concrete and shall be perpendicular to the exposed face. All joints shall be shaped to conform to the contour of the finished section in which they are installed. All material shall be a minimum of ½ inch thick or as indicated. Wood materials shall be anchored to the adjacent concrete to permanently hold them in place. Joint sealer shall be installed in accordance with the manufacturer’s recommendations.

The material used for side walk expansion joints shall conform to 408.2 (3) above, unless otherwise indicated.

The material used for curb and gutter expansion joints filler shall conform to any in 408.2 above, except when placed adjacent to concrete pavement, the joint material shall match the pavement joint material.

408.4 Measurement and Payment
No additional compensation will be made for materials, equipment or labor required by this item, but shall be considered subsidiary to the various items included in the contract.
End
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ITEM NO. 411
SURFACE FINISHES FOR CONCRETE

411.1 Description
This item shall govern the furnishing of all materials and the application by the methods of construction indicated on the Drawings for the application of a surface finish to concrete.

411.2 Materials
(1) Masonry Sand
Masonry sand shall conform to ASTM C 144.

(2) White Cement
White cement shall conform to ASTM C 150.

(3) Portland Cement
All cement unless otherwise indicated shall be Portland cement conforming to ASTM C 150.
Portland cement manufactured in a cement kiln fueled by hazardous waste shall be considered as an approved product if the production facility is authorized to operate under regulation of the Texas Commission on Environmental Quality (TCEQ) and the U. S. Environmental Protection Agency (EPA). Supplier shall provide current TCEQ and EPA authorizations to operate the facility.

(4) Membrane Curing
Membrane curing shall conform to Item No. 409, "Membrane Curing".

(5) Adhesive Grout
This subsection sets forth the requirements for three epoxy adhesives with different viscosity's designed to bond fresh Portland Cement concrete to existing Portland Cement concrete, hardened concrete to hardened concrete and steel to fresh or hardened concrete. These adhesives are as follows:

Type V: Standard (medium viscosity) for applying to horizontal and vertical surfaces. This material is suitable for surface sealing of fine cracks in concrete.

Type VI: Low viscosity for application with spray equipment to horizontal surfaces.

Type VII: Paste consistency for overhead application and where a high buildup is required. This material is suitable for surface sealing of cracks in concrete, which are veed out prior to sealing, and for grouting of dowel bars where clearance is 1/16 inch or less.
(a) Mixing Ratio: The ratio of resin and hardener components to be mixed together to form the finished adhesive shall be either 1 to 1 or 2 to 1 by volume.

Any specific coloring of resin and/or hardener components desired will be stated by the Engineer.

(b) Fillers, pigments and thixotropic agents: All fillers, pigments and/or thixotropic agents in either the epoxy resin or hardener component must be of sufficiently fine particle size and dispersed so that no appreciable separation or settling will occur during storage.

Any fillers present in the low viscosity version must be of such a nature that they will not interfere with application by spray equipment or abrade or damage such equipment.

The concrete adhesive shall contain no volatile solvents.

(c) Consistency: The adhesives shall comply with the following:

<table>
<thead>
<tr>
<th></th>
<th>Type V</th>
<th>Type VI</th>
<th>Type VII</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viscosity of mixed</td>
<td>400 Maximum</td>
<td>150 Maximum</td>
<td>must be sufficiently fluid to apply by trowel or spatula without difficulty</td>
</tr>
<tr>
<td>adhesive 77 ±1 F,</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poises</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pot Life at 77 F,</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>minutes minimum - 30</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Set Time at 77 F (Time required to attain 180 psi), hours maximum - 12</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Thixotropy test shall be performed at both 77 and 120 F. Average thickness of cured adhesive remaining on test panel, mils minimum.

<table>
<thead>
<tr>
<th></th>
<th>Type V</th>
<th>Type VII</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>30</td>
<td>45</td>
</tr>
</tbody>
</table>

Samples of the individual components in sealed containers shall be maintained at 115 + 3 F for 2 weeks. The mixed adhesive prepared from these samples must still comply with the minimum thixotropy requirements.

The viscosity of the Type V and Type VI versions must not show an increase of more than 20 percent compared with the viscosity prior to the stability test. The Type VII adhesive must still be sufficiently fluid to apply by trowel or spatula without difficulty.

(d) Physical Properties of the Cured Adhesive
(6) Synthetic Resin Paint

Type X Epoxy: This is a high solids epoxy coating designed for application by brush or roller. The materials can also be applied by airless spray by addition of a maximum of 5 percent toluene solvent at the direction of the Engineer.

Raw Materials: The basic raw materials to be incorporated into this coating are listed below, along with the specific requirements for each material. The final decision as to the quality of materials shall be made by the Engineer. After the Engineer has approved the brand names of raw materials proposed by the Contractor, no substitution will be allowed during the manufacture without prior approval of the Engineer.

Epoxy Resin: The basic epoxy resin used in the formulation shall be an unmodified liquid resin conforming to the following chemical and physical requirements:

<table>
<thead>
<tr>
<th>Property</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viscosity at 25.0 + 0.1 C, cps</td>
<td>7,000 to 10,000</td>
</tr>
<tr>
<td>Weight per epoxy equivalent, gms per gm - mole</td>
<td>175 to 195</td>
</tr>
<tr>
<td>Color (Gardner Number), maximum</td>
<td>5</td>
</tr>
<tr>
<td>Hydrolyzable chlorine, maximum % by weight</td>
<td>0.2</td>
</tr>
<tr>
<td>Specific gravity, 25/25 degrees</td>
<td>1.14 to 1.18</td>
</tr>
</tbody>
</table>

Test methods to be used in determining these qualities are listed below:

(a) Viscosity - Test for Kinematic Viscosity (ASTM Designation: D 445).
(b) Weight per Epoxy Equivalent - Test for Epoxy Content of Epoxy Resins (ASTM Designation: D 1652).
(c) Color - Test for Color of Transparent Liquids (Gardner Color Scale) (ASTM Designation: D 1544).
(d) Hydrolyzable Chlorine - Test for Hydrolyzable Chlorine Content of Liquid Epoxy Resins (ASTM Designation D: 1726).
Pigment

Titanium Dioxide: The titanium dioxide used in this formulation shall be equivalent to DuPont R-900. This shall be a pure, chalk-resistant, rutile titanium dioxide meeting the requirements of ASTM D 476, Type III.

Extender: The extender used in this formulation shall be Nyad 400, manufactured by Interpace Pigments. Specific requirements are as follows:

<table>
<thead>
<tr>
<th>Particle size distribution</th>
<th>Minimum</th>
<th>Maximum</th>
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</thead>
<tbody>
<tr>
<td>Minus 20 microns, percent by weight</td>
<td>95</td>
<td></td>
</tr>
<tr>
<td>Minus 10 microns, percent by weight</td>
<td>70</td>
<td>80</td>
</tr>
<tr>
<td>Minus 5 microns, percent by weight</td>
<td>40</td>
<td>50</td>
</tr>
<tr>
<td>Minus 3 microns, percent by weight</td>
<td>30</td>
<td>40</td>
</tr>
<tr>
<td>Minus 1 micron, percent by weight</td>
<td>14</td>
<td>20</td>
</tr>
<tr>
<td>Oil Absorption (rub out, lbs/100 lbs)</td>
<td></td>
<td>25 maximum</td>
</tr>
<tr>
<td>Brightness (G.E.)</td>
<td>92.5 minimum</td>
<td></td>
</tr>
</tbody>
</table>

411.3 Grade of Finish

(1) General

The grade and/or class of finish shall be as described herein and as indicated. "Grade" of finish designates the areas to which a higher finish is to be applied beyond the requirements of an Ordinary Surface Finish. Four grades of finish are included herein.

"Class" of finish designates the materials or the process to be used in providing the grade of finish. Three classes of finish are included herein.

For structures and surfaces not described herein under grade of finish, a class of finish only may be indicated. Where neither a grade nor class is specified, an Ordinary Surface Finish only will be required as specified in Item No. 410, "Concrete Structures".

Where the plans specify a grade and class of finish, i.e., Grade II, Class C, only that type of finish shall be furnished.

Where the plans specify a grade of finish only, i.e., Grade I Finish, any of the classes of finish may be furnished. Only one class of finish shall be furnished on any individual structure, twin structures or on structures in close proximity to each other, except as specified for prestressed concrete members below.
(2) Grade I
The following areas shall receive a Class A, B or C (two rub) Finish, except that prestressed members shall receive either a Class A or B Finish only.

All concrete surfaces of railing, including the parapet types; exterior vertical faces of slabs, slab spans, arches and box girders; the outside and bottom surfaces of fascia beams or girders (including prestressed members); the underside of overhanging slabs to the point of juncture of the supporting beam; all exposed vertical surfaces of bents and piers and bottom surfaces of bent caps; all exposed surfaces of tie beams, abutments, bridge wingwalls, culvert headwalls and wingwalls and retaining walls exposed to view after all backfill and is placed.

Unless otherwise indicated, the underside of the slab of slab spans shall be finished its entire width.

Unless otherwise indicated, exposed surfaces of pump houses and other miscellaneous concrete surfaces shall receive a Class A, B or C (one rub) Finish.

(3) Grade II
All concrete surfaces of railing, including the parapet types, all exposed surfaces of bridge wingwalls and the exterior vertical faces of slabs and slab spans shall receive a Class A, B or C (two rub) Finish. All other surfaces described under Grade I Finish shall receive a Class A or B finish only. The underside of slab spans shall receive an Ordinary Surface Finish only.

(4) Grade III
All concrete surfaces of railing, including the parapet types, all exposed surfaces of bridge wingwalls and the exterior vertical faces of slabs shall receive a Class A, B or C (two rub) Finish. All other surfaces described under Grade I Finish shall receive an Ordinary Surface Finish.

(5) Grade IV
The top and roadway faces only of all concrete railing, including the parapet types and bridge wingwalls shall receive a Class A, B or C (one rub) Finish. All other surfaces described under Grade I shall receive an Ordinary Surface Finish.

411.4 Class of Finish
The Class of Finish designates either an adhesive grout material, a paint-type material or a rubbing process applied to surfaces specified in "Grade of Finish", as required above and/or as indicated.

Unless otherwise indicated the color shall be concrete gray.
(1) Class A
This finish shall consist of an adhesive grout textured coating with a minimum 1/16 inch thickness, composed of 1 part white cement, 1 part natural (gray) cement, 2 parts masonry sand, 1 part (latex) emulsion and enough water to form a viscous slurry of a consistency that may be applied by spray gun, brush or roller without appreciable running or sagging. The proportions of white and gray cement may be varied slightly to obtain the desired color.

Gradation of the masonry sand shall be as required to produce a texture satisfactory to the Engineer.

Prepackaged materials meeting these requirements and acceptable to the Engineer as to color, texture and appearance will be permitted.

(2) Class B
The finish shall be a paint-type material, consisting of a synthetic resin, containing fibrous as well as texturing pigments, which when applied by a 1 coat spray application at the rate of 45 + 5 square feet per gallon will yield an acceptable textured coating. Certification by the manufacturer of the above materials will be required.

(3) Class C
This finish shall consist of a one rub or two rub system, as the case may be, meeting the requirements set forth below under "Construction Methods".

411.5 Approval of Surface Finishing Materials
The material to be furnished shall meet the requirements of TxDOT Specification D-9-8110, Structural Coatings, latest revision.

In addition to the above, the manufacturer shall furnish the following:

(1) At the time of original request for approval of the surface finishing material, the manufacturer shall supply a 1-gallon sample of the material to the Engineer, if requested.

(2) Each 6 months after approval of the material, the manufacturer shall furnish a notarized certification indicating that the material originally approved has not been changed or altered in any way. Any change in formulation of a surface finish shall require retesting prior to use.

The Engineer may request additional information to be submitted such as infrared spectrophotometry scan, solids content, etc., for further identification. A change in formula discovered by any of the tests prescribed herein or by other means and not reported and retested, may be cause to permanently bar the manufacturer from furnishing surface finish materials for Owner's/Developer’s work.

The Owner/Developer reserves the right to perform any or all of the tests required by this specification as a check on the tests reported by the manufacturer. In case of any variance, the Owner/Developer tests will govern.
411.6 Construction Methods

Prior to application of any of the finishes required herein, concrete surfaces shall be given an Ordinary Surface Finish. For Class A and B materials, concrete surfaces shall be clean and free of dirt, grease, curing compound or any other bond breaking substance. Class A shall be applied on moistened surfaces but Class B requires a dry surface. The temperature of the atmosphere, concrete and compound shall be above 50 F for Classes A and B at the time of application. The finished surfaces shall be protected against rain or freezing for a period of 24 hours after application.

Class A materials shall be applied by spraying, by roller or by brush. Class B materials shall be applied by spraying only. All applications shall provide an acceptable texture of the proper coverage.

The Class A and B material shall be applied after all preparation work required by Ordinary Surface Finish has been completed.

The Class C Finish shall be performed with a carborundum stone as follows, after all preparatory work required by Ordinary Surface Finish has been completed:

For a two-rub system, the first rubbing shall bring the wetted concrete face to a paste and produce a smooth dense surface without pits, form marks or other irregularities. The use of cement or grout to form the paste will not be permitted. Striping with a brush and washing after the first rubbing will not be required. Chamfer lines shall be finished during the second rubbing.

The first rubbing shall be done soon after form removal. Membrane curing, if used, shall be applied after the first rub is complete. Prior to the second rubbing, any remaining curing membrane shall be removed from the surface by brushing, buffing or other satisfactory methods.

The second rubbing shall be performed when conditioning the structure for final acceptance. The specified surfaces shall be cleaned of drip marks and discolorations and given a final rubbing. The surface shall be striped neatly with a brush and the paste allowed to take a reset, after which the surfaces shall be washed with clean water leaving them with a neat and uniform appearance and texture.

For a one rub system, the rubbing requirements shall be the same as for the first rub above, except chamfer lines shall be finished and the paste spread uniformly, striped with a brush and allowed to take a reset after which the surfaces shall be washed with clean water leaving them with a neat and uniform appearance and texture.
411.7 Special Surfaces Finishes

(1) General

When special surface finishes are required for retaining walls, panels, copings or similar construction, the Contractor shall prepare sample panels for approval of the finish and the method of application. Unless otherwise indicated, panel or pattern arrangement and dimensions may be varied to achieve a more pleasing appearance or to utilize forming material more efficiently when approved by the Engineer/Architect. Aggregates, materials, variation of panel or pattern arrangement, dimensions and other features affecting the work shall be approved prior to start of the work.

(2) Striated Finish

The striated (grooved) pattern shall be as indicated or as approved by the Engineer.

The finish shall be made by lining the forms with striated sheets of plywood, plastic, fiberglass, metal or other material acceptable to the Engineer. The striations on the panels shall be of a smooth, wide pattern, not sharp or angular.

A chamfer groove shall be used along all edges of each panel. All ties, bolts or other forming accessories shall be located along the chamfer grooves or panel edges.

(3) Exposed Aggregate Finish

(a) Structural Concrete

Exposed aggregate panels may be either raised, recessed or as indicated with the sides of each panel chamfered as directed by the Engineer.

The aggregate used for this finish shall be approved by the Engineer. Unless otherwise indicated, aggregate shall conform to the grading requirements of Grade 2 aggregate except that a minimum of 50 percent shall be retained on the ¾-inch sieve. Gravel of predominately rounded particles shall be used, except that when indicated or approved by the Engineer in writing, crushed stone may be used. The aggregate shall be large enough to remain firmly anchored in the face of the final product. The depth shall be 1/4-inch minimum to 1/2-inch maximum, unless otherwise indicated or directed by the Engineer.

A surface retarder that penetrates the concrete approximately 1/4 inch shall be applied to the forms or concrete surface as an aid in achieving the desired finish. Wood forms may require 2 or 3 coatings to compensate for absorption. Form joints shall be taped or caulked to prevent escape of the retarder during placing operations.

Treated form surfaces shall be protected from sun and rain while exposed to the atmosphere. In case of high humidity or if rain has dampened the forms prior to placing concrete, a reapplication of the surface retarder may be required to provide uniform coverage of the retarder on the forms.
Adjacent areas of fresh concrete not requiring exposed aggregate finish shall be protected when the retarder is applied.

The finish shall be obtained by sandblasting, bush hammering, water blasting or other methods, as approved by the Engineer. Horizontal surfaces may be finished by a combination of brushing and washing, but only after the concrete has set sufficiently to prevent loosening of the aggregate.

Unless otherwise directed by the Engineer, forms for surface requiring exposed aggregate finish shall be removed 12 to 15 hours after concrete placement. The exposed aggregate operation shall be accomplished immediately after form removal. Except for the time required for obtaining the exposed aggregate finish, curing of all surfaces shall be maintained for the minimum 4 day curing time. All surfaces shall be either water cured or may be cured with an approved clear membrane compound. If water curing is used, it shall be followed by a clear membrane curing compound conforming to Item No. 409, "Membrane Curing".

Care shall be taken to ensure proper vibration at all points of concrete placement to prevent honeycomb or segregation of the materials. Vibration shall be done in such a manner as to provide adequate penetration of previously placed concrete lifts. Care shall be taken to prevent contact of the vibrator with the face form.

(b) Sidewalks

When exposed aggregate surfaces are required for sidewalks, driveways and/or medians, the coarse aggregate shall consist of particles with at least 40 percent crushed faces. Uncrushed gravel, polished aggregates and clear resilient coatings are not acceptable. Grade 5 coarse aggregates shall be used for exposed aggregate finishes for sidewalks, driveways and/or medians.

411.8 Measurement and Payment

No direct measurement or payment will be made for the work to be done, the equipment or materials to be furnished under this item, but shall be considered subsidiary to the particular items required by the plans and the contract.

End

Ref.: 409
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ITEM NO. 413
CLEANING AND/OR SEALING JOINTS
AND CRACKS (PORTLAND CEMENT CONCRETE)

413.1 Description
This item shall govern the cleaning and/or sealing of joints and cracks in either new or existing Portland cement concrete pavements and bridge decks in conformance with the requirements herein and the details indicated on the Drawings or as established by the Engineer or designated representative.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

413.2 Submittals
The submittal requirements of this specification item include:
A. Sealant Type (Rubber-Asphalt, Polymer Modified Emulsion, Low Modulus Silicone or Polyurethane), Class and method of application (crack sealing, joint sealing, etc),
B. Manufacturer recommendations concerning the use of primer and backer rod
C. Manufacturer recommended equipment and procedures for preparation, dispensing, application, curing, etc. of the sealant
D. Manufacturer certification that the product to be supplied meets or exceeds the specifications,
E. Listing of the equipment proposed for the Work.

413.3 Materials
Joints and/or cracks shall be sealed with the type and/or class of materials indicated on the Drawings. The materials shall conform to the requirements of TxDOT Specification Item No. 433, “Joint Sealants and Fillers” and TxDOT Departmental Materials Specification No. DMS-6310, “Joint Sealants and Seals”.

Primers, if required, shall be as recommended by the manufacturer of the sealant. Backer rods, when required, shall be compatible with the sealant and shall not react with or bond to the sealant.

The sealing compound shall be delivered in the manufacturer's original sealed containers. Each container shall be legibly marked with the name of the manufacturer, the trade name of the sealer, the manufacturer's batch number or lot, the pouring temperature, and the safe heating temperature.

413.4 Equipment
All equipment shall be in accordance with the sealant manufacturer's recommendations. Air compressors shall be equipped with appropriate filters for removing oil and water from the air.
Any equipment, that damages dowels, reinforcing steel, Portland cement concrete, base, subbase or subgrade in the process of cleaning the joints and/or cracks, shall be discontinued and the joint and/or crack shall be cleaned by other methods approved by the Engineer or designated representative, which do not cause such damage.

413.5 Construction Methods

Equipment, tools and machinery recommended for proper prosecution of the Work shall be on the project and shall be approved by the Engineer or designated representative prior to the initiation of the joint and/or crack cleaning and sealing operations.

A. Joint and Crack Preparation.

The bonding surface of cracks and joints shall be cleaned of infiltrated material, saw cuttings or other foreign material. All material removed from joints and cracks shall be removed from the paved surface of the roadway.

No sealing of any joints or cracks shall be done when the joints or cracks are damp, unless drying of the joints and cracks with compressed air can be demonstrated and meets with the approval of the Engineer or designated representative.

1. Joint Preparation.

The joints shall be cleaned with filtered compressed air or other methods approved by the Engineer or designated representative. Unless noted otherwise on the Drawings, hand tools, air guns, power routers, abrasive equipment or other equipment may be used to clean the joints. Where indicated on the Drawings, the joint sealant space shall be resized by sawing to the width and depth shown on the Drawings to accommodate the type of sealant specified.

2. Crack Preparation.

Unless indicated otherwise on the Drawings, the crack shall be grooved initially at the surface so that a reservoir of rectangular cross section is provided for the sealant. The grooves shall be cut to the dimensions shown on the Drawings. The devices that are used for grooving, such as diamond blade random cut saws, random-crack grinders, etc., shall be capable of following the path of the crack without causing excessive spalling or other damage to the concrete.

B. Joint and Crack Sealing

The sealant shall be installed in accordance with the manufacturer’s recommended procedure. The joint and/or crack surfaces shall be surface dry unless recommended otherwise by the manufacturer of the sealant.

The surface temperature at the time of the sealing operation shall not be less than 40°F (4.5°C).

The minimum depth of sealant shall be ½ inch (12.5 mm) or a depth recommended by the sealant manufacturer and the top of the sealant shall be located 1/8 to ¼ inch (3 to 6.5 mm) below the adjacent pavement surface.
1. Primer.
   If required, the primer shall be applied as soon as possible after cleaning is accomplished. The primer shall be applied uniformly at the rate recommended by the sealant manufacturer. The primer shall be applied to exposed metal surfaces before new corrosion begins and shall be allowed to cure for a minimum of thirty (30) minutes, but no longer than eight (8) hours prior to the application of the sealant, unless sealant manufacturer recommendations indicate otherwise.

2. Backer Rods.
   Backer rods shall be used to prevent a fluid type sealant from flowing through the joint and crack and to retain the sealant at its required elevation. The application and use of backer rod shall be as recommended by the sealant manufacturer and approved by the Engineer or designated representative.

413.6 Measurement
Accepted work performed under this item shall be considered subsidiary to other pay items and will not be measured and paid for unless a separate pay item is provided in the contract documents.

If a pay item is included in the contract documents, acceptable work for "Cleaning and/or Sealing Joints and Cracks" shall be measured by the lineal foot (meter: 1 meter equals 3.281 feet) of sealant in place.

If a pay item is included in the contract documents, acceptable work "Cleaning and/or Sealing Joints and Cracks" shall be measured by the pound (kilograms: 1 kilogram equals 2.205 pounds).

413.7 Payment
When included as a pay item in the contract documents, the work performed and materials furnished as provided by this item and measured in accordance with Article 413.6, "Measurement", will be paid for at the appropriate unit bid price bid. The unit bid prices shall include full compensation for cleaning and, if necessary, grooving and/or sawing the crack/joint; furnishing, hauling and placing primer and backer rod, if necessary; furnishing, heating, hauling, and placing the crack/joint sealer; all freight involved and all manipulations, labor, tools, equipment and incidentals necessary to complete the work.

Payment, when included as a contract pay item, will be made under:
   
   _____________ Sealer  Per Lineal Foot.

   _____________ Sealer  Per Pound of Sealer Used.

End
### Specific Cross Reference Materials

<table>
<thead>
<tr>
<th>Specification Item 413, “Cleaning and/or Sealing Joints and Cracks (Portland Cement Concrete)”</th>
</tr>
</thead>
</table>

Texas Department of Transportation: *Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges*

<table>
<thead>
<tr>
<th>Designation</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>Item No. 433</td>
<td>Joint Sealants and Fillers</td>
</tr>
<tr>
<td>Item No. 438</td>
<td>Cleaning and/or Sealing Joints and Cracks (Portland Cement Concrete)</td>
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Texas Department of Transportation: *Departmental Materials Specifications*

<table>
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<tr>
<th>Designation</th>
<th>Description</th>
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<tbody>
<tr>
<td>DMS 6310</td>
<td>Joint Sealants and Seals</td>
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### Related Cross Reference Materials

<table>
<thead>
<tr>
<th>Specification Item 413, “Cleaning and/or Sealing Joints and Cracks (Portland Cement Concrete)”</th>
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</table>

City of Round Rock Standard Specifications

<table>
<thead>
<tr>
<th>Designation</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>Item No. 301</td>
<td>Asphalts, Oils and Emulsions</td>
</tr>
<tr>
<td>Item No. 313</td>
<td>Cleaning and/or Sealing Joints and Cracks (Asphaltic Concrete)</td>
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</tbody>
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Texas Department of Transportation: *Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges*

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<td>Asphalts, Oils and Emulsions</td>
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ITEM NO. 432S
P. C. CONCRETE SIDEWALKS

432.1 Description
This item shall govern the construction of Portland cement concrete sidewalks, as herein specified, on an approved subgrade and in conformance with the lines, grades and details indicated on the Drawings or as established by the Engineer or designated representative.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text inch-pound units are given preference followed by SI units shown within parentheses.

432.2 Submittals
The submittal requirements of this specification item include:
A. Class A p.c. concrete mix design,
B. Type of Installation (i.e. Type I, Type II, etc.) and construction details (i.e. cushion layer, base, reinforcing steel, joints, curing membrane),
C. Identification of the type, source, mixture, Pure Live Seed (PLS) and rate of application of the seeding.

432.3 Materials
A. Portland CementConcrete
   Portland cement concrete shall be Class A conforming to Specification Item No. 403, "Concrete for Structures".
B. Reinforcement
   Reinforcement shall conform to Specification Item No. 406, "Reinforcing Steel".
C. Expansion Joint Materials
   Expansion joint materials shall conform to Specification Item No. 408, "Expansion Joint Materials".
D. Membrane Curing Compound
   Membrane curing compound shall conform to Specification Item No. 409, "Membrane Curing".

432.4 Construction Methods
The subgrade shall be excavated in accordance with Specification Item No. 111, "Excavation", prepared in accordance with Specification Item No. 201, "Subgrade Preparation", shaped to the lines, grades and cross section as indicated on the Drawings or as directed by the Engineer or designated representative and thoroughly compacted in accordance with Specification Item No. 201. A granular cushion of a minimum thickness of 2 inches (50 mm) but maximum thickness of 5 inches (125 mm),
composed of crusher screenings, gravel and sand, crushed rock or coarse sand, shall be spread, wetted thoroughly, tamped and leveled. The granular cushion shall be moist at the time the Portland cement concrete is placed.

If the subgrade is undercut by more than 4 inches (100 mm) or the elevation of the natural ground is more than 4 inches (100 mm) below “top of subgrade”, then a necessary backfill/embankment layer of an approved material shall be placed and compacted with a mechanical tamper. Hand tamping will not be permitted.

Where the subgrade is rock or gravel, 70 percent of which is rock; the 2-inch (50 mm) cushion need not be used. The Engineer or designated representative will determine if the subgrade meets the above requirements.

Sidewalk forms shall be constructed of metal or well-seasoned wood not less than 2 inches (50 mm) in thickness, with a section satisfactory to the Engineer or designated representative. The forms shall be clean, straight, and free from warp with a depth equal to the thickness of the finished work. All forms shall be securely staked to line and grade and maintained in a true position during the deposition of Portland cement concrete. Before p.c. concrete is placed, the forms shall be thoroughly oiled with a light form oil.

Expansion joint material 3/4 inch (19 mm) thick, shall be provided where the new construction abuts an existing structure, sidewalk or driveway. Similar expansion material shall be placed around all obstructions protruding through the sidewalk. The expansion joint material shall be placed vertically and shall extend the full depth of the p.c. concrete. Maximum spacing of expansion joints shall be 40 feet (12 meters) as indicated on the Drawings or as directed by the Engineer or designated representative. Weakened plane joints shall be spaced at 5 feet (1.5 meters) on center. Normal dimensions of the weakened plane joints shall be 1/4 inch wide and 3/4 inch deep (6 mm wide and 19 mm deep). All joints shall be constructed perpendicular (90 degrees) to the centerline of walk and shall match any previously placed concrete joints.

Reinforcement for sidewalks shall consist of 1 layer of 6 x 6 – W2.9 x W2.9(150 x 150 – MW19 x MW19) wire fabric or #3 (10M) bars, placed not more than 18 inches (450 mm) on center both directions. All reinforcement shall be placed equidistant from the top and bottom of the p.c. concrete. Care shall be exercised to keep all steel in its proper position during placement of the p.c. concrete. Splices in wire fabric shall overlap sufficiently to allow two pairs of transverse wires to be tied together and no splice of less than 6 inches (150 mm) will be permitted. Splices in the #3 (10M) bars shall have a minimum lap of 12 inches (300 mm).

Where driveways cross sidewalks, additional reinforcing shall be placed in the sidewalk as indicated on the Drawings.

Portland cement concrete shall be placed in the forms and spaded, tamped and thoroughly consolidated until it entirely covers the surface and has a monolithic finish. The top surface shall be floated and troweled to a uniform smooth surface; then finished with a broom or wood float to a gritty texture unless indicated otherwise on the Drawings or as directed by the Engineer or designated representative. The outer edges and joints shall be rounded with approved tools to a 1/4-inch (6 mm) radius. Care will be
exercised to prevent loss of dummy joints or rounded edges when applying the brush finish.

Portland cement concrete sidewalk ramps shall be stamped or formed to produce a finished surface with detectable warnings in accordance with the requirements of the American Disabilities Act and Texas Accessibility Standards (TAS), including Sections 4.29.2 and A4.29.2. The p.c. concrete sidewalk ramps shall be constructed in accordance with appropriate City of Round Rock Standard Details.

Detectable warning for the ramps shall consist of raised truncated domes with a diameter of nominal 0.9 inch (23 mm), a height of nominal 0.2 inch (5 mm) and center-to-center spacing of nominal 2.35 inches (60 mm) and shall contrast visually with adjoining surfaces, either light on dark or dark-on-light. The material used to provide contrast shall be an integral part of the walking surface.

When indicated on the Drawings or as directed by the Engineer or designated representative, the construction of the sidewalk ramp shall include the installation of interlocking concrete paving units (Standard Specification Item No. 480, "Concrete Paving Units"). The concrete paving units shall be constructed in accordance with Standard Specification Item No. 485, "Concrete Paving Units for Sidewalk Ramps" and appropriate City of Round Rock Standard Details.

At the proper time after finishing, the surface shall be protected by a membrane compound curing agent or by wetted cotton or burlap mats, and cured in accordance with Item No. 410 “Concrete Structures”. The sides of the p.c. concrete shall be cured in the forms. If the forms are removed during the curing process, the curing shall be continued by the placement of fill against the exposed concrete edges or by other procedures conforming to Item No. 410, "Concrete Structures". The top 4 inches (100 mm) of fill shall be clean topsoil conforming to Item No. 604, "Seeding for Erosion Control".

Existing sidewalk that is scheduled for removal and replacement shall be removed and the underlying material shaped to the lines, grades and cross section as indicated in the drawings or as directed by the Engineer or designated representative. The removal and/or relocation of obstructions, including but not limited to signs, trash cans and benches on concrete pads, abandoned manholes, sprinkler control valves and landscaping, shall be performed, as indicated on the drawings, in a manner acceptable to the Engineer or designated representative. Removal and/or relocation of obstructions will be considered incidental work to this item and will not be paid for directly.

Existing PVC pipe drains in and behind curb shall be removed and replaced as required in new sidewalk and/or curb and gutter. In areas of proposed sidewalk construction, where curb and gutter is to remain in place, existing PVC pipe shall be cut far enough behind the back of curb to allow sufficient room for joint fittings to connect to new or salvaged PVC pipe.

The Contractor shall be responsible for removing and replacing mailboxes that are located in the construction area, while assuring that mail delivery will not be interrupted as a result of the construction activities. Mailboxes shall not be laid on the ground.
All necessary excavation, filling and grading of the slopes adjacent to the completed concrete sidewalks will be considered incidental work pertaining to this item and will not be paid for directly. The adjacent excavation and grading of the slopes shall be done in a manner acceptable to the Engineer or designated representative.

432.5 Measurement
Accepted work performed as prescribed by this item will be measured by the square foot (square meter: 1 square meter is equal to 10.764 square feet) of surface area of “Concrete Sidewalk”. Accepted work performed as prescribed by “Sidewalk Ramps” will be measured per each for the type of ramp indicated on the Drawings.

432.6 Payment
The work performed as prescribed by this item will be paid for at the unit bid price per square foot for “Concrete Sidewalk” and/or “Sidewalks Reconstruction” or per each for “Concrete Sidewalk Ramps”. The unit bid price shall include full compensation for excavating and/or removal of existing sidewalk and other obstructions, relocating obstructions, replacing PVC drain pipe, re-vegetating adjacent areas disturbed by sidewalk construction, preparing the subgrade; for furnishing and placing all materials including cushion material, all reinforcement, joints, expansion joint materials, and for any other materials, manipulations, labor, tools, equipment, finishing, curing and incidentals necessary to complete the work.

Payment will be made under one of the following:

**NewSidewalks**
- New P.C. Concrete Sidewalks, 4 Inch thickness Per Square Foot.
- New P.C. Concrete Sidewalks, 5 Inch thickness Per Square Foot.
- New P.C. Concrete Sidewalks, 6 Inch thickness Per Square Foot.
- New P.C. Concrete Sidewalks, 7 Inch thickness Per Square Foot.

**Sidewalks Reconstruction**
- Reconstruct Concrete Sidewalks to 4 Inch thickness, including removal of existing sidewalk Per Square Foot.
- Reconstruct Concrete Sidewalks to 5 Inch thickness, including removal of existing sidewalk Per Square Foot.
- Reconstruct Concrete Sidewalks to 6 Inch thickness, including removal of existing sidewalk Per Square Foot.
- Reconstruct Concrete Sidewalks to 7 Inch thickness, including removal of existing sidewalk Per Square Foot.
Ramps

P.C. Sidewalk Curb Ramp with Pavers (Type I) Per Each.
P.C. Sidewalk Curb Ramp with Pavers (Type IA) Per Each.
P.C. Sidewalk Curb Ramp with Pavers (Type IB) Per Each.
P.C. Sidewalk Curb Ramp with Pavers (Type IC) Per Each.

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American Disabilities Act, Federal Register: Volume 56, No. 144; July 26, 1991
ADA Accessibility Guidelines For Building And Facilities

| Designation | Description |
| Section 4.29 | Detectable Warnings on Walking Surfaces |
| Section A4.29.2 | Detectable Warnings on Walking Surfaces |

Architectural Barriers: Texas Civil Statutes, Article 9102; June 14, 1995
Texas Accessibility Standards (TAS)

| Designation | Description |
| Section 4.29 | Detectable Warnings on Walking Surfaces |
| Section A4.29.2 | Detectable Warnings on Walking Surfaces |
RELATED CROSS REFERENCE MATERIALS

Specification 432, “P. C. CONCRETE SIDEWALKS”

City of Round Rock Standard Specifications

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Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges

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American Disabilities Act, Federal Register; Volume 56, No. 144; July 26, 1991
ADA Accessibility Guidelines For Building And Facilities

Designation          | Description          |
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Section 4.3.6        | Surface Texture      |
Section 4.3.7 & 4.7.2 | Slope                |
Section 4.3.8 & 4.5.2 | Changes in Levels   |
Section 4.7           | Curb Ramps           |
Section 4.8           | Ramps                |

Architectural Barriers; Texas Civil Statutes, Article 9102; June 14, 1995
Texas Accessibility Standards (TAS)
ITEM NO. 509
TRENCH SAFETY SYSTEMS

509.1 Description
This item shall govern the following:

A. Designing, furnishing, and installing a Trench Safety System for trench excavation;
B. Dewatering the area as specified on the Drawings and/or required; and
C. Maintenance and removal of the trench safety systems as determined by Contractor's Trench Safety Engineer and/or Contractor's Competent Person(s).

This Item also includes special clearing, excavation and backfilling for safety systems. At a minimum, this work shall conform to United States Department of Labor Rules 29 CFR, Part 1926 Occupational Safety and Health Administration (OSHA). The Competent Person(s) shall be on the project whenever workers are in an excavation trench.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

509.2 Trench Safety System Plan Submittal
Prior to, or at the Pre-Construction Conference, the Contractor shall submit to the Owner/Developer a Trench Safety System Plan sealed by a registered Professional Engineer licensed in the State of Texas. Notice to Proceed with construction will not be issued by the Owner until the Contractor has submitted a Trench Safety System Plan to the Owner/Developer.

The Trench Safety System Plan at a minimum shall conform to OSHA standards for sloping of sides, utilization of trench boxes, and/or utilization of shoring, sheeting and bracing methods. The Contractor shall be responsible for obtaining the geotechnical information necessary for the design of the Trench Safety System Plan [normally acquired from borings taken at 500 foot (150 meter) intervals along the proposed centerline to a minimum depth of five feet (1.5 meters) below proposed flowline]. If the geotechnical information for the design of the improvements is acquired by the Owner/Developer or designated representative, it shall be provided to the Contractor for information purposes subject to the provisions of the Contract.

The Trench Safety System Plan submittal shall include:

A. A Drawing or plan indicating specific designation of areas in which each type of system will be used, including the length of trench to be opened, the length of time that the trench will remain open, the means of egress, the storage of materials, allowable loads on trench walls, the methods for placing/compacting bedding/backfill within the safety system, any equipment restrictions and the subsequent removal of system,

B. Drawings or manufacturer's data, as applicable, that describe the various elements of the Trench Safety System in sufficient detail that the workers can properly install the Trench Safety System,
C. Recommendations and limitations for using systems.

D. Sealed engineering calculations and/or equipment manufacturer's certifications, as applicable, that confirm that the system is designed to withstand the anticipated loadings and that it can be fully installed/implemented in the designated space easement provided.

E. A Certificate of Insurance of the Trench Safety Engineer's Professional Liability Insurance coverage meeting the requirements of the Contact.

F. Certificate of Completion of an OSHA-approved program indicating that the Contractor's Competent Person(s) has received training in "Excavation Safety".

509.3 Trench Safety System Plan Review
The review of the Trench Safety System Plan that will be conducted by the Owner/Developer or designated representative shall only relate to general conformance with OSHA standards and regulations. The Owner's/Developer's failure to note exception(s) to the submittal shall not relieve the Contractor of any or all responsibility or liability for the Trench Safety System Plan. The Contractor shall remain solely and completely responsible for all trench safety systems and for the associated means, methods, procedures, and materials.

509.4 Construction Methods
The Contractor's Competent Person(s) shall be responsible for the maintenance of a copy of appropriate OSHA regulations onsite and the implementation of OSHA trenching safety regulations at the work site. Trenching shall be completed to the lines and grades indicated on the Drawings or as specified in various technical standard specification items requiring excavation and trenching and/or backfilling. The Contractor shall perform all trenching in a safe manner and shall maintain safety systems to prevent death or injury to personnel or damage to structures, utilities or property in or near the excavation.

If evidence of possible cave-ins or earthen slides is apparent or an installed trench safety system is damaged, the work in the trench shall immediately cease, personnel evacuated from hazardous area and the Owner/Developer notified. Personnel shall not be allowed to re-enter the excavation until necessary repairs or replacements are completed and are inspected and approved by the Contractor's Competent Person(s). Repair and replacement of damaged safety system shall be at the Contractor's sole expense.

509.5 Changed Conditions
When changed conditions require modifications to the Trench Safety System, the Contractor shall provide to the Owner/Developer or designated representative a new design or an alternate Trench Safety System that is proposed by the Contractor's Trench Safety Engineer to address the changed conditions encountered. Copies of the new design or alternate system shall be provided to the Owner/Developer or designated representative in accordance with the requirements of section 509.2, "Trench Safety
System Plan Submittal". A copy of the most current Trench Safety System shall be maintained on site and made available to inspection and enforcement officials at all times.

Any changes to the Trench Safety System Plan that are initiated by the Contractor for operational efficiency or as a result of changed conditions, that could be reasonably anticipated, will not be cause for contract time extension or cost adjustment. When changes to the Trench Safety System Plan are necessitated by severe and uncharacteristic natural conditions or other conditions totally out of the control of the Contractor, the Contractor may make a written request to the Owner/Developer for a Change Order to address the anticipated work. The Contractor shall notify the Owner/Developer in writing within 24 hours of the occurrence of changed conditions that the Contractor anticipates the submittal of a claim for additional compensation. Under 'Changed Conditions" the work deemed immediately necessary by the Contractor to protect the safety of workers and public, equipment or materials may only be accomplished until the Owner/Developer or designated representative has a reasonable opportunity to investigate the Contractor's written request for a Change Order and respond in writing to the request.

509.6 Measurement
Trench Safety Systems shall be measured by lineal foot (meter: 1 meter equals 3.281 feet) through manholes and other appurtenances along the centerline of trench conforming to the Drawings and specifications.

509.7 Payment
Payment for Trench Safety Systems, measured as prescribed above, will be made at unit bid price per centerline lineal foot of trench per the Drawings and specifications. The unit bid price shall include full compensation for designing, furnishing, installing the system; for dewatering, maintenance, replacement and removal of the Trench Safety Systems and for sloping, special clearing, and excavation necessary to safely implement the Trench Safety System Plan.

Payment will be made under the following:

| Trench Safety Systems (all depths) | Per Lineal Foot. |

END
### RELATED Cross Reference Materials

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ITEM NO. 510
PIPE

510.1 Description
This item shall consist of furnishing and installing all pipe and/or materials for constructing pipe mains, sewers, laterals, stubs, inlet leads, service connections and culverts, including all applicable Work such as excavating, bedding, jointing, backfilling materials, tests, concrete trench cap, concrete cap and encasement, etc., prescribed under this item and in accordance with the provisions of the Edwards Aquifer Protection Ordinance, when applicable. The pipe shall be of the sizes, types, class and dimensions indicated or as designated by the Engineer or designated representative and shall include all joints or connections to new or existing mains, pipes, sewers, manholes, inlets, structures, etc., as may be required to complete the Work in accordance with specifications and published standard practices of the trade associations for the material specified and to the lines and grades indicated. This item shall include any pumping, bailing, drainage and Item No. 509, "Trench Safety Systems" for trench walls, when indicated or applicable. Unless otherwise provided, this item shall consist of the removal and disposition of trees, stumps and other obstructions, old structures or portions thereof such as house foundations, old sewers, masonry or concrete walls, the plugging of the ends of abandoned piped utilities cut and left in place and the restoration of existing utilities damaged in the process of excavation, cutting and restoration of pavement and base courses, the furnishing and placing of select bedding, backfilling and cement or lime stabilized backfill, the hauling and disposition of surplus materials, bridging of trenches and other provisions for maintenance of traffic or access as indicated.

510.2 Materials
The Contractor shall submit descriptive information and evidence that the materials and equipment the Contractor proposes for incorporation into the Work is of the kind and quality that satisfies the specified functions and quality.

1. Concrete
   Concrete shall conform to Item No. 403, "Concrete for Structures".

2. Coarse Aggregate
   Coarse aggregate shall conform to Item No. 403, "Concrete for Structures" or one of the following:
   (a) Pipe Bedding Stone
       Pipe bedding stone shall be clean gravel, crushed gravel or crushed limestone, free of mud, clay, vegetation or other debris, conforming to ASTM C 33 for stone quality. Size gradation shall conform to ASTM C-33 No. 57 or No. 67 or the following Table:
(b) Foundation Rock
Foundation rock shall be well graded coarse aggregate ranging in size from 2 to 8 inches.

(c) Flexible Base
Flexible base shall conform to Item No. 210, "Flexible Base".

(3) Fine Aggregate
(a) Concrete and Mortar Sand
Fine aggregate shall conform to Item No. 403, "Concrete for Structures".

(b) Bedding Sand
Sand for use as pipe bedding shall be clean, granular and homogeneous material composed mainly of mineral matter, free of mud, silt, clay lumps or clods, vegetation or debris. The material removed by decantation TxDOT Test Method Tex-406-A, plus the weight of any clay lumps, shall not exceed 4.5 percent by weight.

The resistivity shall not be less than 3000 ohms-cm as determined by TxDOT Test Method Tex-129-E. Size gradation of sand for bedding shall be as follows:

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<th>SIEVE SIZE</th>
<th>% RETAINED BY WEIGHT</th>
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<tbody>
<tr>
<td>1/4&quot;</td>
<td>0</td>
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<tr>
<td>#60</td>
<td>75-100</td>
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<td>#100</td>
<td>95-100</td>
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(c) Stone Screenings
Stone screenings shall be free of mud, clay, vegetation or other debris, and shall conform to the following Table:

<table>
<thead>
<tr>
<th>SIEVE SIZE</th>
<th>% RETAINED BY WEIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-1/2&quot;</td>
<td>0</td>
</tr>
<tr>
<td>1&quot;</td>
<td>0-10</td>
</tr>
<tr>
<td>1/2&quot;</td>
<td>40-85</td>
</tr>
<tr>
<td>#4</td>
<td>90-100</td>
</tr>
<tr>
<td>#8</td>
<td>95-100</td>
</tr>
</tbody>
</table>
All screenings shall be the result of a rock crushing operation.

(4) Controlled Low Strength Material

Controlled Low Strength Material (CLSM) shall conform to Item No. 402, "Controlled Low Strength Material."

(5) Pea Gravel

Pea gravel bedding shall be clean washed material, hard and insoluble in water, free of mud, clay, silt, vegetation or other debris. Stone quality shall meet ASTM C 33. Size gradation shall be as follows:

<table>
<thead>
<tr>
<th>SIEVE SIZE</th>
<th>% RETAINED BY WEIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/4&quot;</td>
<td>0</td>
</tr>
<tr>
<td>1/2&quot;</td>
<td>0-25</td>
</tr>
<tr>
<td>1/4&quot;</td>
<td>90-100</td>
</tr>
</tbody>
</table>

(6) Select Backfill or Borrow

This material shall consist of borrow or suitable material excavated from the trench. It shall be free of stones or rocks over 8 inches and shall have a plasticity index of less than 20. The moisture content at the time of compaction shall be within 2 percent of optimum as determined by TxDOT Test Method Tex-114-E. Sandy loam borrow will not be allowed unless shown on the Drawings or authorized by the Engineer or designated representative.

All suitable materials from excavation operations not required for backfilling the trench may be placed in embankments, if applicable. All unsuitable materials that cannot be made suitable shall be considered surplus excavated materials as described in 510.3(13). The Contractor may, if approved by the engineer, modify unsuitable materials to make them suitable for use. Modification may include drying, removal or crushing of over-size material, and lime or cement treatment.
(7) Cement Stabilized Backfill

When indicated or directed by the Engineer or designated representative, backfill shall be with cement-stabilized backfill rather than the usual materials. Unless otherwise indicated, cement stabilized backfill material shall consist of a mixture of the dry constituents described for Class J Concrete. The cement and aggregates shall be thoroughly dry mixed with no water added to the mixture except as may be directed by the Engineer or designated representative.

(8) Pipe

General

Fire line leads and fire hydrant leads shall be ductile iron. Domestic water services shall not be supplied from fire service leads, unless the domestic and fire connections are on separately valved branches with an approved backflow prevention device in the fire service branch. All wastewater force mains shall be constructed of ductile iron pipe Pressure Class 250 minimum for pipe greater than 12-inch size and Pressure Class 350 for pipe 12-inch size and smaller. Wastewater pipe shall have a corrosion resistant interior lining acceptable to the Owner/Developer.

For pipes 16” and larger all pipe manufacturers and suppliers shall be certified by the American National Standards Institute (ANSI) for ISO 9000 compliance. It is the intent of this certification that all appropriate tests be documented with sampling criteria, frequency of testing, date of testing and date in which every piece was manufactured. A copy of the testing data to include results shall be sent with the shipment with appropriate identification as it relates to the specific shipment.

The quality of materials, the process of manufacture and the finished pipe shall be subject to inspection and approval by the Engineer or designated representative at the pipe manufacturing plant and at the project site prior to and during installation. Plant inspections shall be conducted at the discretion of the Owner/Developer and shall require only 48 hours of advance notice to the manufacturer. Only manufacturers and suppliers meeting this certification will be considered as approved providers of products.

All water distribution pipe and fittings shall be listed in the Fire Protection Equipment Directory published by the Underwriter's Laboratories, Inc., or shall be Factory Mutual approved for fire service.

(a) Reserved

(b) Iron Pipe

Iron pipe shall be ductile iron pipe meeting all requirements of standards as follows:

-For push-on and mechanical joint pipe: AWWA C-151
-For flanged pipe: AWWA C-115
Barrels shall have a nominal thickness required by Table 1 of AWWA C-115, which thickness corresponds to Special Class 53 in sizes through 54 inch, and Class 350 in 60 and 64-inch sizes. Flanges shall be ductile iron (gray iron is not acceptable); they shall be as shown in ANSI/AWWA C115/A21.15 and shall conform to dimensions shown in Table 2 and Figure 1 of AWWA C115. These flanges are the same in all respects as flanges shown in ANSI/AWWA C110/A21.10 for fittings and are standard for all flanges used with pipe, valve, and equipment units in the City of Round Rock water distribution and wastewater force main systems. Flanges shall be fabricated and attached to the pipe barrels by U.S. fabricators using flanges and pipe barrels of U.S. manufacture. If fabrication is to be by other than the pipe barrel manufacturer, a complete product submittal and approval by the City of Round Rock will be required. Additionally, such fabricator shall furnish certification that each fabricated joint has been satisfactorily tested hydrostatically at a minimum pressure of 300 psi.

-Linings and Coating:

Interior surfaces of all iron water pipe shall be cement-mortar lined and seal coated as required by AWWA C104. Interior surfaces of all iron wastewater line and force main pipe shall be coated with a non-corrosive lining material as approved by the City of Round Rock. Pipe exteriors shall be coated as required by the applicable pipe specification. The type and brand of interior lining shall be clearly marked on the outside of the pipe and fittings. Except as authorized by the Engineer or designated representative, only one type and brand of pipe lining shall be used on a given project. Except as described above for flanged pipe (Thickness Class 53) and where not otherwise indicated, ductile iron pipe shall be minimum Class 250 as defined by ANSI/AWWA C150/A21.50-current; all ductile iron pipe and flanges shall meet the following minimum physical requirements:

Grade 60-42-10:
- Minimum tensile strength: 60,000 psi (414 mPa).
- Minimum yield strength: 42,000 psi (290 mPa).
- Minimum elongation: 10 percent.

The flanges for AWWA C115 pipe may be also be made from:

Grade 70-50-05:
- Minimum tensile strength: 70,000 psi (483 mPa).
- Minimum yield strength: 50,000 psi (345 mPa).
- Minimum elongation: 5 percent.
1. **Ductile Iron Fittings:**

   Fittings shall be push-on, flanged or mechanical joint as indicated or approved and shall meet all requirements of standards as follows:
   - Sizes 4 inch through 24 inch: AWWA C-110 or AWWA C-153
   - Sizes larger than 24 inch: AWWA C-110.

   **Lining and Coating:**

   Interior surfaces or all iron water pipe fittings shall be lined with cement-mortar and seal coated as required by AWWA C104. Interior surfaces of all iron wastewater and force main fittings shall be coated with a non-corrosive lining material acceptable to the City of Round Rock. Fitting exteriors shall be coated as required by the applicable pipe specification.

2. **Joint Materials**

   Gaskets for mechanical joints shall conform to ANSI/AWWA A21.11/C-111.

   Joining of slip joint iron pipe shall, without exception, be accomplished with the natural or synthetic rubber gaskets of the manufacturer of that particular pipe being used. A joint lubricant shall be used and applicable recommendations of the manufacturer shall be followed.

   Gaskets for flanged joints shall be continuous full face gaskets, of 1/8 inch minimum thickness of natural or synthetic rubber, cloth-reinforced rubber or neoprene material, preferably of deformed cross section design and shall meet all applicable requirements of ANSI/AWWA A21.11/C-111 for gaskets. They shall be manufactured by, or satisfy all recommendations of, the manufacturer of the pipe/fittings being used and be fabricated for use with Class 125 ANSI B16.1 flanges.

   Tee-head bolts, nuts and washers for mechanical joints shall be high strength, low alloy, corrosion resistant steel stock equal to "COR-TEN A" having UNC Class 2 rolled threads or alloyed ductile iron conforming to ASTM A 536; either shall be fabricated in accordance with ANSI/AWWA A21.11/C-111.

   Hex head bolts and nuts shall satisfy the chemical and mechanical requirements of ASTM A449 SAE Grade 5 plain, and shall be fabricated in accordance with ASTM B 18.2 with UNC Class 2 rolled threads.

   Either Tee-Head or Hex-Head bolts, nuts and washers as required, shall be protected with bonded fluoro-polymer corrosion resistant coating where specifically required by the Engineer or designated representative.

   All threaded fasteners shall be marked with a readily visible symbol cast, forged or stamped on each nut and bolt, which will identify the fastener material and grade. The producer and the supplier shall provide adequate literature to facilitate such identification; painted markings are not acceptable.
3 Polyethylene Film Wrap
All iron pipe, fittings and accessories shall be wrapped with standard 8 mil (minimum) low density polyethylene film or 4-mil (minimum) cross laminated high-density polyethylene conforming to AWWA C-105, with all edges overlapped and taped securely with duct tape to provide a continuous wrap to prevent contact between the piping and the surrounding backfill. All punctures of the polyethylene, including those caused by the placement of bedding aggregates, shall be repaired with duct tape to restore the continuous protective wrap before backfilling.

4 Marking
Each pipe joint and fitting shall be marked as required by the applicable AWWA specification. This includes in all cases: Manufacturer's identification, Country where cast, year of casting, and "DUCTILE" or "DI". Barrels of flanged pipe shall show thickness class; others shall show pressure class. The flanges of pipe sections shall be stamped with the fabricators identification; fittings shall show pressure rating, the nominal diameter of openings and the number of degrees for bends. Painted markings are not acceptable.

(c) Concrete
1. General
Pipe shall conform to ASTM C 76 for Circular Pipe. Concrete pipe smaller than 12 inches in diameter shall conform to ASTM C 14, Extra Strength. All pipe shall be machine made or cast by a process which will provide uniform placement of the concrete in the form and compaction by mechanical devices, which will assure a dense concrete. Concrete shall be mixed in a central batch plant or other approved batching facility from which the quality and uniformity of the concrete can be assured. Transit mixed concrete shall not be acceptable for use in precast pipe. The pipe shall be Class III or the class indicated. Storm sewer pipe shall be of the tongue and groove or 0-ring joint design. Wastewater pipe shall be of the 0-ring joint design; it shall be acceptably lined for corrosion protection.

2. Marking
Each joint of pipe shall be marked with the pipe class, the date of manufacture, the manufacturer's name or trade mark, diameter of pipe and orientation, if required.
Pipe marking shall be waterproof and conform to ASTM C 76.

3. Minimum Age for Shipment
Pipe shall be considered ready for shipment when it conforms to the tests specified in ASTM C 76.
4. Joint Materials

When constructing storm sewers, the Contractor shall have the option of making joints with either of the following materials:

a. Mortar

Mortar for joints shall meet the requirements set forth below in "Mortar".

b. Cold Applied Preformed Plastic Gaskets

Cold Applied Plastic Gaskets shall be suitable for sealing joints of tongue and groove concrete pipe. The gasket sealing the joint shall be produced from blends of refined hydrocarbon resins and plasticizing compounds reinforced with inert mineral filler and shall contain no solvents, irritating fumes or obnoxious odors. The gasket joint sealer shall not depend on oxidizing, evaporating or chemical action for its adhesive or cohesive strength and shall be supplied in extruded rope form of suitable cross section. The size of the plastic gasket joint sealer shall be in accordance with the manufacturer's recommendations and sufficient to obtain squeeze-out around the joint. The gasket joint sealer shall be protected by a suitable removable wrapper that may be removed longitudinally without disturbing the joint sealer to facilitate application.

The chemical composition of the gasket joint sealing compound as shipped shall meet the following requirements:

<table>
<thead>
<tr>
<th>Composition (% by weight)</th>
<th>Test Method</th>
<th>Typical Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bitumen (petroleum plastic content)</td>
<td>ASTM D 4</td>
<td>50-70</td>
</tr>
<tr>
<td>Ash-inert Mineral Water</td>
<td>Tex-526-C</td>
<td>30-50</td>
</tr>
<tr>
<td>Volatile Matter (at 325° F)</td>
<td>Tex-506-C</td>
<td>2.0 Maximum</td>
</tr>
</tbody>
</table>

The gasket joint sealing compound when immersed for 30 days at ambient room temperature separately in 5 percent solution of caustic potash, a mixture of 5 percent hydrochloric acid, a 5 percent solution of sulfuric acid and a saturated H₂S solution shall show no visible deterioration.

The physical properties of the gasket joint sealing compound as shipped shall meet the following requirements:
<table>
<thead>
<tr>
<th>Property</th>
<th>Test Method</th>
<th>Typical Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specific Gravity at 77°F</td>
<td>ASTM D 71</td>
<td>1.20</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1.35</td>
</tr>
<tr>
<td>Ductility at 77°F (cm) Minimum</td>
<td>Tex-503-C</td>
<td>5.0</td>
</tr>
<tr>
<td>Softening point</td>
<td>Tex-505-C</td>
<td>275°F</td>
</tr>
<tr>
<td>Penetration:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>32°F (300 g) 60 sec</td>
<td>Tex-502-C</td>
<td>75</td>
</tr>
<tr>
<td>77°F (150 g) 5 sec</td>
<td>Tex-502-C</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td></td>
<td>120</td>
</tr>
<tr>
<td>115°F (150 g) 5 sec</td>
<td>Tex-502-C</td>
<td>150</td>
</tr>
<tr>
<td>Flashpoint C.O.C. F</td>
<td>Tex-504-C</td>
<td>600°F</td>
</tr>
<tr>
<td>Fire Point C.O.C. F</td>
<td>Tex-504-C</td>
<td>625°F</td>
</tr>
</tbody>
</table>

When constructing wastewater lines, the Contractor shall use 0-ring gasket joints conforming to ASTM C 443. Just before making a joint, the ends of the pipe shall be clean, dry, free of blisters or foreign matter and shall be wire brushed. For O-ring joints, the gasket and the inside surface of the bell shall be lubricated with a light film of soft vegetable soap compound to facilitate assembly of the joint. The rubber O-ring gasket shall be stretched uniformly in the joint. Wedge seal type ("Forsheda" pre-lubricated) gaskets may be used if joint details submitted are approved; installation of such gaskets shall be in strict accordance with the manufacturer's recommendations, and shall be the sole element depended upon to make the joint flexible and watertight.

In wastewater lines no horizontal or vertical angles in the alignment of pipes shall be permitted unless indicated. The spigot shall be centered in the bell, the pipe pushed uniformly home and brought into true alignment. Bedding material shall be placed and tamped against pipe to secure the joint.

5. Bends

When horizontal or vertical angles in the alignment of storm sewers are indicated, the bend or angle shall be constructed by use of prefabricated bends meeting the specification requirements. All bends shall be watertight, have a smooth flow line and be equal or greater in strength to the adjacent pipe.

Horizontal or vertical changes in alignment in wastewater lines shall be accomplished by use of manholes. With the Engineer's or designated representative's approval, horizontal changes in alignment may be made.
by the "Joint Deflection" method. Joint deflection is limited by regulations of the Texas Commission on Environmental Quality (TCEQ) to 80 percent of the maximum recommended by the manufacturer; such deflection may not exceed 5 degrees at any joint. Changes in alignment using pipe flexure shall not be allowed.

6. Sulfide and Corrosion Control

All concrete pipe used for wastewater installations shall be protected from sulfide and corrosion damage by using limestone aggregate.

(d) Concrete Steel Cylinder (CSC) Pipe

1. General Requirements

The Contractor shall submit to the Engineer or designated representative for approval along with other required data a tabulated layout schedule with reference to the stationing and grade lines to be used.

The manufacturer shall furnish all fittings and special pieces required for closures, bends, branches, manholes, air valves, blow offs and connections to main line valves and other fittings as indicated.

Each pipe length, fitting and special joint shall have plainly marked on the bell end of the pipe the head condition for which it is designed. In addition, marking shall be required to indicate the location of each pipe length or special joint in the line and such markings will be referenced to the layout schedules and drawings submitted for approval.

Concrete steel cylinder fittings shall be tested as required by the applicable AWWA Standards.

2. Design and Inspection

Where not otherwise indicated, concrete steel cylinder pipe shall be Class 200, designed to withstand a vacuum of not less than 28 feet of water. Valve reducers, tees and outlets from a pipe run shall be designed and fabricated so that all stresses are carried by the steel forming the fitting or outlet.

Concrete steel cylinder pipe shall meet one of the following specifications:

AWWA C-301 - Any Size

AWWA C-303 - 24-inch maximum size

All pipe flanges shall conform to AWWA C-207, requirements for standard steel flanges of pressure classes corresponding to the pipe class.

Pipe to be installed in a tunnel or encasement shall be manufactured with 1 inch thick by 24-inch wide skid bands of mechanically impacted mortar in addition to the normal coating.

All concrete steel cylinder fittings shall be constructed of steel plate of adequate strength to withstand both internal pressure and external loading. Rod reinforcing shall not be used to figure the required steel area.
The fittings shall have a concrete lining and 1 inch minimum coating of cement mortar, except that centrifugally spun lining need not be reinforced.

Minimum lining thickness shall be 1/2 inch for 16-inch pipe and 3/4 inch for sizes larger than 16-inch pipe. Where it is impractical to place such concrete protection on interior surfaces of small outlets, 2 coats of "Bitumastic Tank Solution" shall be applied.

No fitting shall be made by cutting of standard pipe, except that outlets of less than 75 percent of the pipe diameter may be placed in a standard pipe. Beveled spigots may be placed on standard pipe.

3. Joint Materials

Joints shall be of the rubber gasket type conforming to the applicable standards. The inside and outside recesses between the bell and spigot shall be completely filled with Cement Grout in accordance with the pipe manufacturer's recommendations. Grout materials for jointing such pipe, unless otherwise indicated, shall be as described herein.

(e) In Place Pipe Rehabilitation

1. In Place Slipping With or Without Pipe Destruction /Replacement.

This item shall consist of installing a high-density polyethylene pipe, by use of a pipe insertion machine into an existing line.

a. Material Requirements

The polyethylene pipe shall meet the following specifications:

ASTM F 714
Plastic Pipe Institute PE3408

Unless otherwise specified, the Contractor shall furnish the polyethylene pipe in accordance with the following table:

<table>
<thead>
<tr>
<th>Depth of Cover in Feet</th>
<th>SDR of Pipe</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 16</td>
<td>17</td>
</tr>
<tr>
<td>Greater than 16</td>
<td>11</td>
</tr>
</tbody>
</table>

b. Functional Requirements

The polyethylene pipe shall be assembled and joined at the site using the thermal butt fusion method. All equipment and procedures shall be in strict compliance with the manufacturer's recommendations. Fusing shall be accomplished by personnel certified as fusion technicians by a manufacturer of polyethylene pipe and/or fusing equipment.

The complete joint shall be in true alignment and have a uniform double roll back bead resulting from the use of proper temperature and pressure. The joint shall be allowed adequate cooling time.
before removal of pressure. Joints shall be made smooth on the inside by removal of the projecting weld bead using appropriate equipment; maximum projection of the weld bead on the exterior of the pipe shall be approximately 3/16 inch. The fused joint shall be watertight and shall have a tensile strength equal to that of the pipe. All joints shall be subject to acceptance by the Engineer or his/her representative prior to placement. All defective joints shall be cut out and replaced.

Any section of the pipe with a gash, abrasion, nick or scar greater in depth than 10 percent of the wall thickness, or containing concentrated ridges, discolorization, excessive spot roughness, pitting, variable wall thickness, or any other defect of manufacturing or handling as determined by the Engineer or his/her representative, shall be discarded and removed from the site.

Terminal sections of pipe that are joined within the insertion pit shall be connected with a full circle pipe repair clamp with a minimum length of one and one half times the nominal inside pipe diameter. The butt gap between pipe ends shall not exceed 1/10 of the nominal inside diameter of the pipe.

c. Installation Procedure

The Contractor shall carry out his operations in strict accordance with all OSHA and manufacturer's safety requirements.

The Contractor shall provide for the flow of water and wastewater around the section or sections of pipe designated for rehabilitation including active services in the rehabilitation section. The bypass shall be made by plugging the line at an existing upstream manhole or adjacent system. The pump and bypass lines shall be of adequate capacity and size to handle the flow. The Contractor shall take all necessary steps to prevent flooding of any private property and shall be liable for damages incurred by the flooding. No sewage or water shall be allowed to drain into earthen sump pits.

New polyethylene pipe shall be inserted immediately behind the expansion and insertion equipment in accordance with the manufacturer's procedures. The expansion and insertion equipment shall be equipped with all controls necessary to place the pipe on proper line and grade according to the Drawings.

The Contractor shall install all pulleys, rollers, bumpers, alignment control devices and other equipment required to protect existing manholes and to protect the pipe from damage during installation.

Lubrication may be used as recommended by the pipe manufacturer. Under no circumstances shall the pipe be stressed beyond its elastic limit.
All active service connections shall be identified by video inspection or other means and connected to the new main in accordance with the plan details.

Upon commencement, insertion, from manhole to manhole, shall be continuous without interruption except as approved by the Engineer or designated representative.

The installed pipe shall be allowed the manufacturer's recommended amount of time to provide for complete shrinkage or relaxation of the pipe prior to any connection of service lines, sealing of the annular space where the pipe enters the manhole, or backfilling of the insertion pit. Sufficient excess length of pipe shall be allowed to provide for this shrinkage.

The pipe bedding in the insertion pit shall be either pea gravel or pipe bedding stone. Bedding and backfill shall conform to the specification requirements of Section 510.3(14) contained herein. All street repairs and pavement replacement shall conform to City of Round Rock Criteria.

The relaxed pipe shall be cut so that it projects 4 inches inside of the manhole and any annular space shall be sealed. Sealing shall be with material approved by the Engineer or designated representative. The sealant shall completely fill the void between the pipe and the manhole wall and shall extend 3 inches beyond the annulus on the inside wall of the manhole. The sealant shall form a smooth transition from the pipe onto the manhole. The complete joint shall be uniform and watertight. A concrete invert shall be poured in place and shaped to form a smooth flow channel through the manhole.

2. Cured Resin Pipe Lining

This method of rehabilitation shall consist of the insertion of a resin-impregnated flexible tube into an existing pipe by the inversion method given in ASTM F 1216 or by a comparable approved method.

a. Material Requirements

Certified copies of all test reports on the properties of the selected resin and on the initial structural properties of the Cured in Place Pipe (CIPP) system—and later, on the field samples from designated inversion lengths as required by Section 8 of ASTM F 1216—shall be submitted to the Owner's/Developer's Engineer or designated representative. All testing costs are incidental to, and shall be included in, the unit price bid for CIPP.
The CIPP system shall have minimum initial structural properties as follows:

- Flexural Strength (ASTM D 790) 4,500 psi
- Tensile Strength (ASTM D 638) 2,500 psi
- Flexural Modulus (ASTM D 790) 250,000 psi

The results of tests by an independent laboratory of specimens taken by the Contractor as required by Section 8 of ASTM F 1216 and to demonstrate compliance with the above minimum values, shall be made available to the Owner's/Developer's Engineer or designated representative at the completion of testing.

b. Installation Procedure

Insertion of a resin-impregnated flexible tube into an existing pipe shall be by an inversion method as given in ASTM F 1216 and the manufacturer's recommendations.

The Contractor shall carry out his operations in strict accordance with all OSHA and manufacturer's safety requirements.

Measures shall be taken to reduce atmospheric styrene concentration to an acceptable level at all times during the CIPP installation procedure. The percent lower explosive limit, temperature and styrene concentration shall be measured and recorded for each inversion taken to ensure the following conditions are met:

- Percent Lower Explosive Limit (LEL) shall not exceed 2% using an atmospheric monitor calibrated within at least six (6) months of the day reading is taken. The LEL shall be measured at the top of the downstream manhole adjacent to the section of pipe being lined.
- No process water shall be discharged until cooled to below 100 degrees Fahrenheit in accordance with Section 7.1 of ASTM F 1216.
- Atmospheric styrene levels shall not exceed 50 ppm as measured by a Drager Tube 67 23 301 Styrene 10/a five feet above and within 3 feet downwind of the downstream manhole adjacent to the section of pipe being lined.
- Contractor shall be responsible for satisfactorily resolving customer complaints involving styrene odors.
- Any necessary repairs to the pipeline shall be performed by the Contractor. Inspection of pipeline by the Contractor shall be performed by experienced personnel trained in locating breaks, obstacles and service connections by closed circuit television. The interior of the pipe shall be carefully inspected to determine the location of any conditions which may prevent proper installation into the pipe and these conditions shall be corrected. A videotape and
log shall be made by the Contractor and provided to the Owner/Developer upon completion of the project.

The Contractor shall provide for the flow of water and wastewater around the section or sections of pipe designated for rehabilitation, including active services in the rehabilitation section. The bypass shall be made by plugging the line at an existing upstream manhole and pumping the flow into a downstream manhole or adjacent system. The pump and bypass lines shall be of adequate capacity and size to handle the flow. The Contractor shall take all necessary steps to prevent flooding of any private property and shall be liable for any damages incurred by the flooding. No sewage or water shall be allowed to drain into earthen sump pits.

The Contractor shall designate a location where the uncured resin in the original containers and the unimpregnated fiber-felt tube shall be vacuum impregnated prior to installation. The Contractor shall allow the Engineer or designated representative to inspect the materials and "wet out" procedure. The quantities of the liquid thermosetting materials shall be per manufacturer's standards to provide the wall thickness specified.

Water for the Work shall be metered and furnished by the Contractor in accordance with the Contract Documents. The wet out fiber-felt tube shall be inserted through an existing manhole or other approved access by means of an inversion process and the application of a hydrostatic head sufficient to fully extend it to the next designated manhole.

Any defect which will affect, in the foreseeable future, or warranty period, the integrity or strength of the pipe liner shall be repaired at the Contractor's expense, in a manner satisfactory to the Engineer or designated representative.

If, due to broken or misaligned pipe at a manhole wall, the pipe liner fails to make a tight seal, the Contractor shall apply a seal at that point. The seal shall be of a resin mixture compatible with pipe liner.

After the pipe liner has been cured in place, and allowed to cool down and normalize to ambient temperature, the Contractor shall connect new services or reconnect existing service piping as designated and identified in the proposal. After the Work is completed, the Contractor shall provide the Engineer or designated representative with a videotape showing both the before and after conditions including the restored connections.

(f) Polyethylene Tubing

1. General

All polyethylene (PE) tubing shall be high density, high molecular weight
plastic tubing meeting ASTM D2737; it shall be pressure rated at 200 psi working pressure and must bear the National Sanitation Foundation seal of approval for potable water service.

When tested for Environmental Stress Cracking, the PE tubing shall not show any loss of pressure in the 6 specimens tested for 3 hours in accordance with the requirements of ASTM D 2737 using the test pressure of 400 psi at 73.4° F.

The minimum burst pressure shall be 630 psi at 73.4° F determined in accordance with ASTM D 1599, latest revision. The time of testing of each specimen shall be between 60 and 70 seconds.

The tubing shall not fail, balloon, burst or weep as defined in ASTM D 1598, latest revision, when tested in accordance with the Sustained Pressure Test Method of ASTM D 2737 but under the following test conditions:

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Time</th>
<th>Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>73.4° F</td>
<td>1,000 hours</td>
<td>400 psi</td>
</tr>
<tr>
<td>100° F</td>
<td>1,000 hours</td>
<td>330 psi</td>
</tr>
</tbody>
</table>

2. Markings

Permanent marking on the tubing shall include the following at intervals of not more than 5 feet:

Nominal tubing size.

Type of plastic material, i.e., PE 3408.

Standard Dimension Ratio (SDR) and pressure rating in psi for water at 73.4° F (e.g., SDR-9, 200 psi).

ASTM D 2737 designation.

Manufacturer's name or trademark, code and seal of approval (NSF mark) of the National Sanitation Foundation.

3. Tube Size

PE tubing shall be standard copper tube size outside diameter, with Standard Dimension Ratio (SDR) of 9. Standard sizes, dimensions and tolerances shall be as follows:

<table>
<thead>
<tr>
<th>Nominal Tube Size (inches)</th>
<th>Outside Diameter, inches</th>
<th>Wall Thickness, inches</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Average</td>
<td>Tolerance</td>
</tr>
<tr>
<td>3/4</td>
<td>0.875</td>
<td>±0.004</td>
</tr>
<tr>
<td>1</td>
<td>1.125</td>
<td>±0.005</td>
</tr>
<tr>
<td>1 1/4</td>
<td>1.375</td>
<td>±0.005</td>
</tr>
<tr>
<td>1 1/2</td>
<td>1.625</td>
<td>±0.006</td>
</tr>
<tr>
<td>2</td>
<td>2.125</td>
<td>±0.006</td>
</tr>
</tbody>
</table>
(g) **Copper Tubing**

All copper service tubing shall be annealed seamless Type K water tube meeting ASTM B88 and rated at 150 psi working pressure. The tubing shall be homogenous throughout and free from cracks, holes, crimping, foreign inclusions or other defects. It shall be uniform in density and other physical properties.

<table>
<thead>
<tr>
<th>Nominal Tube Size, inches</th>
<th>Outside Diameter, inches</th>
<th>Wall Thickness, inches</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Average</td>
<td>Tolerance</td>
</tr>
<tr>
<td>3/4</td>
<td>0.875</td>
<td>± 0.003</td>
</tr>
<tr>
<td>1</td>
<td>1.125</td>
<td>± 0.0035</td>
</tr>
<tr>
<td>1 1/4</td>
<td>1.375</td>
<td>± 0.004</td>
</tr>
<tr>
<td>1 1/2</td>
<td>1.625</td>
<td>± 0.0045</td>
</tr>
<tr>
<td>2</td>
<td>2.125</td>
<td>± 0.005</td>
</tr>
</tbody>
</table>

(h) **Service Connection Fittings**

All fittings used in customer service connection - tapping mains, connecting meters, etc. - must be approved by the City of Round Rock.

(i) **Brass Goods**

All brass valves, couplings, bends, connections, nipples and miscellaneous brass pipe fittings and accessories used in meter connections, service lines, air release piping assemblies, and wherever needed in the water distribution system, shall conform to the City of Round Rock Standards Details, and AWWA C-800, and, shall be approved by the City of Round Rock.

Unless otherwise noted, the goods described herein shall be fabricated of standard Red Brass (Waterworks Brass) meeting ASTM B62 or B584, alloy 83600, consisting of 85 percent copper and 5 percent each of tin, lead and zinc.

Exposed threads shall be covered with plastic caps or sheeting to protect the threads.

Brass goods of each type and class shall be compatible with other fittings in common usage for similar purposes. Where not otherwise indicated, all such materials shall meet the following requirements:

Inlet threads of corporation valves shall be AWWA iron pipe (IP) thread (male); outlets of service saddles shall be tapped with AWWA IP thread (female). AWWA IP threads shall conform to ANSI/ASME B1.20.1 as required by AWWA C800 for “General Purpose (Inch) Pipe Threads”. For 3/4” and 1” sizes only, corporation valve inlet threads, and the internal threads of saddles may be the AWWA taper thread conforming to AWWA C800 Figure 1 and Table 6. External threads of corporation valve inlet must be compatible with internal threads of the service saddle.
Connections of all new tubing, and of tubing repairs wherever possible, shall be by flared fittings. Flare connections - and compression connections when permitted - shall be designed to provide a seal and to retain the tubing, without slippage, at a working water pressure of 150 psig.

Flanges shall conform to ANSI B16.1, Class 125, as to dimensions, drillings, etc. Copper tubing, when used, shall be Type K tubing having dimensions and weights given in Table A.1 of AWWA C800.

Brass pipe shall conform to the weights and dimensions for Extra Strong pipe given in Table A.2 of AWWA C800.

All fittings shall be suitable for use at hydrostatic working pressures up to 150 psig (hydrostatic testing of installed systems is at 200 psig).

(j) Reserved

(k) Polyvinyl Chloride Water Pipe

1. General

All polyvinyl chloride (PVC) water pipe shall be of the rigid (UNPLASTICIZED) type and must bear the National Sanitation Foundation seal of approval for potable water pipe. Each joint of pipe shall consist of single continuous extrusion; bells or other components attached by solvent welding are not acceptable. Pipe shall be pressure rated at 200 psi (SDR-14).

Pipe shall have push-on, rubber gasket joints of the bell and spigot type with thickened integral bells with rubber gasket joints. The wall thickness of each pipe bell and joint coupling must be greater than the standard pipe barrel thickness. Clearance must be provided in every gasket joint for both lateral pipe deflection and for linear expansion and contraction. Concrete thrust blocking shall be placed behind bends and tees. Concrete support cradles or blocking shall be required for support of all fire hydrants, valves and AWWA C110 fittings; such support shall be provided for AWWA C153 fittings when required by the Engineer or designated representative.

2. Applicable Specifications

Except as modified or supplemented herein, PVC pipe shall meet the following standards:

AWWA C-900, SDR 14 for PVC Pressure Pipe, in 4, 6, 8 and 12 inch nominal sizes, having Cast Iron Pipe size outside diameters.

Fittings used with PVC Pressure pipe shall be AWWA C-110 or AWWA C-153 compact ductile iron fittings.

Standard sizes, dimensions and tolerances shall be as follows:
All pipe 4 inches and larger must be approved by Underwriter's Laboratories for use in buried water supply and fire protection systems.

3. Material Requirements

All pipe and fittings shall be made from clean, virgin, NSF approved, Class 12454B PVC. Clean reworked materials generated from the manufacturers own production may be used within the current limits of the referenced AWWA C-900.

4. Marking

Permanent marking on each joint of pipe shall include the following at intervals of not more than 5 feet:

Nominal pipe size and OD base (e.g., 4 CIPS).

Type of plastic material (e.g., PVC 12454B).

Standard Dimension Ratio and the pressure rating in psi for water at 73° F (e.g., SDR 14, 200 psi).

AWWA designation with which the pipe complies (e.g., AWWA C-900).

Manufacturer’s name or code and the National Sanitation Foundation (NSF) mark.

5. Tracer Tape

For all non-metallic pipe, directly above the centerline of the pipe and a minimum of 12 inches below the subgrade, or a minimum of 18 Inches below finished grade on areas outside the limits of pavement, shall be placed Inductive Tracer Detection Tape in accordance with the manufacturer’s requirements. The tape shall be encased in a protective, inert, plastic jacket and color-coded in accordance with APWA Uniform Color Code.
(I) Polyvinyl Chloride (PVC) Pipe (Nonpressure) and Fittings

1. General
Where PVC sewer or wastewater pipe is indicated, it shall conform to ASTM D 3034. Cell Class shall be as required by applicable ASTM pipe specification; pipe stiffness shall be 115 psi minimum for pipe to 15" size, or 72 psi minimum for larger pipe.

2. Joint Material
PVC pipe and fitting shall have elastomeric gasket joints conforming to ASTM D 3212; gaskets to ASTM F 477.

3. Pipe Markings
Permanent marking on the pipe shall include the following at intervals of not more than 5 feet:
   - Manufacturer's name and/or trademark.
   - Nominal pipe size.
   - PVC cell classification per ASTM D 1784.

ASTM designation and legend:
For pipe 6 inch to 15-inch size: ASTM D 3034, type PSM, SDR-26 PVC Sewer Pipe.
For pipe 18 inches and larger: ASTM F 679. T-1 wall PVC sewer pipe.

4. Fitting Markings
Fittings shall be clearly marked as follows:
   - Manufacturer's name or trademark,
   - Nominal size,
   - The material designation "PVC",
   - PSM, and
   - The designation, "Specification D3034".

5. Tracer Tape
For all non-metallic pipe, directly above the centerline of the pipe and a minimum of 12 inches below the subgrade, or a minimum of 18 inches below finished grade on areas outside the limits of pavement, shall be placed Inductive Tracer Detection Tape in accordance with the manufacturer's requirements. The tape shall be encased in a protective, inert, plastic jacket and color-coded in accordance with APWA Uniform Color Code.
(m) Steel Pipe
   1. Standard Weight
      ASTM A 53, Schedule 40.
   2. Extra Heavy Weight
      Seamless ASTM A 53, Schedule 80.
   3. Encasement Pipe
      Welded or Seamless pipepiles ASTM A-252, Grade 2.
   4. Fittings
      Nipples and fittings extra strong Federal Specification WW-N 351 or WW-P 521.
   5. Coatings
      Black or galvanized as indicated.

(n) Welded Steel Pipe and Fittings for Water Pipe
      Specifications of the American Water Works Association (AWWA) listed below shall apply to this Section.
      C-200 Steel Water Pipe 6 inches and larger.
      C-205 Cement-Mortar Protective Lining and Coating for Steel Water Pipe, 4 inches and larger, Shop Applied.
      C-206 Field Welding of Steel Water Pipe.
      C-207 Steel Pipe Flanges for Waterworks Services, Sizes 4 inches through 144 inches.
      C-208 Dimensions for Steel Water Pipe Fittings.
      C-602 Cement-Mortar Lining of Water Pipelines, 4 inches and larger in Place.
   2. Submittals
      Furnish Shop Drawings, product data, design calculations and test reports as described below:
      a. Certified copies of mill tests confirming the type of materials used in steel plates, mill pipe flanges and bolts and nuts to show compliance with the requirements of the applicable standards.
      b. Complete and dimensional working drawings of all pipe layouts. Shop Drawings shall include the grade of material, size, wall thickness of the pipe and fittings, type and location of fittings and the type and limits of the lining and coating systems of the pipe and fittings.
c. Product data to show compliance of all couplings, supports, fittings, coatings and related items.

3. Job Conditions
   a. The internal design pressure of all steel pipe and fittings shall be as indicated.
   b. The interior of all steel pipe for potable water, 4 inches and larger, shall be cement-mortar lined.

4. Manufacturing
   a. Description
      Pipe shall comply with AWWA C-200.
      (1) Circumferential deflection of all pipe in-place shall not exceed 2.0 percent of pipe diameter.
      (2) Diameter
      Nominal pipe diameter shall be the inside diameter of lining or pipe barrel, unless otherwise designated in Job Conditions.
   b. Wall Thickness
      (1) Steel pipe wall thickness shall be designed for the internal and external loads specified in this section. The cylinder thickness needed to resist internal pressure shall be based on an allowable stress in the steel equal to 1/2 the minimum yield stress of the material used.

5. Fittings
   a. Welded
      Fabricated steel fittings shall be of the same material as pipe and shall comply with AWWA C-208.

6. Flanges
   a. Flanges shall comply with the requirements of AWWA C-207, Class D or Class E. The class shall be based on operating conditions and mating flanges of valves and equipment.
   b. Gaskets shall be cloth-inserted rubber, 1/8 inch thick.
   c. Flanges shall be flat faced with a serrated finish.

7. Pipe Joints
   a. Lap Joints for Field Welding
      (1) Lap joints for field welding shall conform to AWWA C-206. This item applies only to pipes 72 inches in diameter and larger.
(2) The bell ends shall be formed by pressing on a hydraulic expander or a plug die. After forming, the minimum radius of curvature of the bell end at any point shall not be less than 15 times the thickness of the steel shell. Bell ends shall be formed in a manner to avoid impairment of the physical properties of the steel shell. Joints shall permit a lap at least 1 1/2 inches when assembled. The longitudinal or spiral weld on the inside of the bell end and the outside of the spigot end on each section of pipe shall be ground flush with the plate surface. The inside edge of the bell and the outside edge of the spigot shall be scarfed or lightly ground to remove the sharp edges or burrs.

b. Bell and Spigot Joints with O-Ring Gasket

(1) Bell and spigot joints with rubber gasket shall conform to AWWA C-200.

(2) The bell and spigot ends shall be so designed that when the joint is assembled, it will be self-centered and the gasket will be confined to an annular space in such manner that movement of the pipe or hydrostatic pressure cannot displace it. Compression of the gasket when the joint is completed shall not be dependent upon water pressure in the pipe and shall be adequate to ensure a watertight seal when subjected to the specified conditions of service. Bell and spigot ends shall be welded on preformed shapes. The bell and spigot ends shall conform to the reviewed Shop Drawings.

8. Interior and Exterior Protective Surface Coatings

a. Exterior Surface to be mortar coated shall conform to AWWA C-205 for shop application and AWWA C-602 for field application. Pipe materials shall be the product of an organization, which has had not less than 5 years successful experience manufacturing pipe materials, and the design and manufacture of the pipe, including all materials, shall be the product of one company.

b. All surfaces except as noted in c and d below shall receive shop application of mortar lining and coating.

c. Field Welded Joints. After installation, clean, line and coat unlined or uncoated ends adjacent to welded field joints, including the weld proper, as specified for pipe adjacent to the weld.

d. Machined Surfaces. Shop coat machined surfaces with a rust preventative compound. After jointing surfaces, remaining exposed surfaces shall be coated per a) and b) above.
Corrugated Metal Pipe

1. General

Pipe shall be corrugated continuous lock or welded seam helically corrugated pipe. Corrugated metal pipe may be galvanized steel, aluminized steel or aluminum conforming to the following:

- Galvanized Steel: AASHTO M 218
- Aluminized Steel: AASHTO M 274
- Aluminum: AASHTO M 197

Where reference is made herein to gage of metal, the reference is to U.S. Standard Gage for uncoated sheets. Tables in AASHTO M 218 and AASHTO M 274 list thickness for coated sheets in inches. The Tables in AASHTO M 197 list thickness in inches for clad aluminum sheets.

Sampling and testing of metal sheets and coils used for corrugated metal pipe shall be in accordance with TXDOT Test Method Tex-708-I.

Damaged spelter coating shall be repaired by thoroughly wire brushing the damaged area and removing all loose, cracked or weld-burned spelter coating. The cleaned area shall be painted with a zinc dust-zinc oxide paint conforming to Federal Specifications TT-P 641b. Damaged pipe shall be rejected and removed from the project.

Damaged aluminized coating shall be repaired in accordance with the manufacturer's recommendations.

The following information shall be clearly marked on each section of pipe:
- Thickness and corrugations
- Trade Mark of the manufacturer
- Specification compliance

2. Fabrication

a. Steel Pipe

Galvanized or aluminized steel pipe shall be full circle or arch pipe conforming to AASHTO M 36, Type I or Type II as indicated.

It may be fabricated with circumferential corrugations; lap joint construction with riveted or spot welded seams or it may be fabricated with helical corrugations with continuous helical lock seam or ultra high frequency resistance butt-welded seams.

b. Aluminum Pipe

Pipe shall conform to AASHTO M 196, Type I, circular pipe or Type II, pipe arch as indicated. It may be fabricated with circumferential corrugations; lap joint construction with riveted or spot welded seams or it may be fabricated with helical corrugations with a continuous helical lock seam.
Portions of aluminum pipe that are to be in contact with high chloride concrete or metal other than aluminum, shall be insulated from these materials by a coating of bituminous material. The coating applied to the pipe or pipe arch to provide insulation between the aluminum and other material shall extend a minimum distance of 1 foot beyond the area of contact.

3. Selection of Gages

The pipe diameter, permissible corrugations and required gages for circular pipe shall be as indicated on the drawings.

For pipe arch, the span, rise, gage, corrugation size and coating thickness shall be as shown on the drawings. A tolerance of plus or minus 1 inch or 2 percent of equivalent circular diameter, whichever is greater, will be permissible in span and rise, with all dimensions measured from the inside crests of the corrugations.

4. Joint Material

Except as otherwise indicated, coupling bands and other hardware for galvanized or aluminized steel pipe shall conform to AASHTO M 36 for steel pipe and AASHTO M 196 for aluminum pipe. Field joints for each type of corrugated metal pipe shall maintain pipe alignment during construction and prevent infiltration of soil material during the life of the installation.

Coupling bands shall be not more than 3 nominal sheet thickness lighter than the thickness of the pipe to be connected and in no case lighter than 0.052 inch for steel or 0.048 inch for aluminum.

Coupling bands shall be made of the same base metal and coating (metallic or otherwise) as the pipe.

Coupling bands shall lap equally on each of the pipes being connected to form a tightly closed joint after installation.

Pipes furnished with circumferential corrugations shall be field jointed with corrugated locking bands. This includes pipe with helical corrugations, which has reformed circumferential corrugations on the ends. The locking bands shall securely fit into at least one full circumferential corrugation on each of the pipe ends being coupled. The minimum width of the corrugated locking bands shall be as shown below for the corrugation which corresponds to the end circumferential corrugations on the pipes being joined:

- 10 1/2 inches wide for 2 2/3 inches x 1/2-inch corrugations.
- 12 inches wide for 3 inches x 1 inch or 5 inches x 1-inch corrugations.

Helical pipe without circumferential end corrugations will be permitted only when it is necessary to join a new pipe to an existing pipe, which was
installed with no circumferential end corrugations. In this event, pipe furnished with helical corrugations at the ends shall be field jointed with either helically corrugated bands or with bands with projections or dimples. The minimum width of helically corrugated bands shall conform to the following:

12 inches wide for pipe diameters up to and including 72 inches.
14 inches wide for 1 inch deep helical end corrugations.

Bands with projections shall have circumferential rows of projections with one projection for each corrugation. The width of bands with projections shall be not less than the following:

12 inches wide for pipe diameters up to and including 72 inches.
   The bands shall have 2 circumferential rows of projections.
16 1/4 inches wide for pipe diameters of 78 inches and greater.
   The bands shall have 4 circumferential rows of projections.

Unless otherwise indicated, all bolts for coupling bands shall be 1/2-inch diameter. Bands 12 inches wide or less shall have a minimum of 2 bolts and bands greater than 12 inches wide shall have a minimum of 3 bolts.

Galvanized bolts may be hot dip galvanized conforming to AASHTO M 232, mechanically galvanized to provide the same requirements as AASHTO M 232 or electro-galvanized per ASTM A 164 Type RS.

5. Additional Coatings or Linings
   a. Bituminous Coated

   Bituminous Coated pipe or pipe arch shall be as indicated both as to base metal and fabrication and in addition shall be coated inside and out with a bituminous coating which shall meet the performance requirements set forth herein. The bituminous coating shall be 99.5 percent soluble in carbon bisulphide. The pipe shall be uniformly coated inside and out to a minimum thickness of 0.05 inch, measured on the crests of the corrugations.

   The bituminous coating shall adhere to the metal tenaciously, shall not chip off in handling and shall protect the pipe from deterioration as evidenced by samples prepared from the coating material successfully meeting the Shock Test and Flow Test in accordance with Test Method Tex-522-C.

   b. Paved Invert

   Where a Paved Invert is indicated, the pipe or pipe arch, in addition to the fully coated treatment described above, shall receive additional bituminous material of the same specification as above, applied to the bottom quarter of the circumference to form a smooth pavement with a minimum thickness of 1/8 inch above the crests of the corrugations.
c. Cement Lined

(1) General

Except as modified herein, pipe shall conform to AASHTO M 36 for lock seam or welded helically corrugated steel pipe. Pipe shall be of full circle and shall be fabricated with two annular corrugations for purposes of joining pipes together with band couplers. Lock seams shall develop the seam strength as required in Table 3 of AASHTO M 36. Concrete lining shall conform to the following:

Composition

Concrete for the lining shall be composed of cement, fine aggregate and water that are well mixed and of such consistency as to produce a dense, homogeneous, non-segregated lining.

Cement

Portland Cement shall conform to AASHTO M 85.

Aggregate

Aggregates shall conform to AASHTO M 6 except that the requirements for gradation and uniformity of gradation shall not apply.

Mixture

The aggregates shall be sized, graded, proportioned and thoroughly mixed with such proportions of cement and water as will produce a homogenous concrete mixture of such quality that the pipe will conform to the design requirements indicated. In no case, however, shall the proportions of Portland Cement, blended cement or Portland Cement plus pozzolanic admixture be less than 470 lb/cu. yd of concrete.

Thickness

The lining shall have a minimum thickness of 1/8 inch above the crest of the corrugations.

Lining Procedures

The lining shall be plant applied by a machine traveling through a stationary pipe. The rate of travel of the machine and the rate of concrete placement shall be mechanically regulated so as to produce a homogenous nonsegregated lining throughout.

Surface Finish

The lining machine shall also mechanically trowel the
concrete lining as the unit moves through the pipe.

Certification

Furnish manufacturer’s standard certification of compliance upon request of the Owner/Developer.

Joints

Pipe shall be joined together with coupling bands made from steel sheets to an indicated thickness of 0.064 inch (12 ga.). Coupling bands shall be formed with two corrugations that are spaced to provide seating in the third corrugation of each pipe end without creating more than 1/2 inch ± annular space between pipe ends when joined together.

Bands shall be drawn together by two 1/2 inch galvanized bolts through the use of a bar and strap suitably welded to the band.

When O-ring gaskets are indicated they shall be placed in the first corrugation of each pipe and shall be compressed by tightening the coupling band. Rubber O-ring gaskets shall conform to Section 5.9, ASTM C 361.

(2) Causes for Rejection

Pipe shall be subject to rejection on account of failure to conform to any of the requirements. Individual sections of pipe may be rejected because of any of the following:

Damaged ends, where such damage would prevent making satisfactory joint.

Defects that indicate poor workmanship and could not be easily repaired in the field.

Severe dents or bends in the metal itself.

If concrete lining is broken out, pipe may be rejected or at the discretion of the Engineer or designated representative, repaired in the field in accordance with the manufacturer's recommendation.

Hairline cracks or contraction cracks in the concrete lining are to be expected and does not constitute cause for rejection.

d. Fiber Bonded

Where fiber bonded pipe is indicated, the pipe or pipe arch shall be formed from sheets whose base metal shall be as indicated. In addition, the sheets shall have been coated with a layer of fibers, applied in sheet form by pressing them into a molten metallic
bonding. If a paved invert is indicated it shall be in accordance with the procedure outlined above. The test for spelter coating above is waived for fiber bonded pipe.

6. Slotted Drain Storm Sewers

The pipes for the slotted drain and slotted drain outfall shall be helically corrugated, lock seam or welded seam pipe. Materials and fabrication shall be in accordance with the above. The metal thickness shall be a minimum 16 gage.

The chimney assemblies shall be constructed of 3/16 inch welded plate or machine formed 14 gage galvanized steel sheets. The height of the chimney required shall be as indicated. Metal for the welded plate slot shall meet the requirements of ASTM A 36 and the completed plate slot shall be galvanized after fabrication in accordance with ASTM A 123.

Weld areas and the heat affected zones where the slot is welded to the corrugated pipe shall be thoroughly cleaned and painted with a good quality asphalt base aluminum paint.

7. Mortar

Mortar shall be composed of 1 part Type I Portland Cement and 2 parts clean, sharp mortar sand suitably graded for the purpose and conforming in other respects to the provisions for fine aggregate of Item No. 403, "Concrete for Structures". Hydrated lime or lime putty may be added to the mix, but in no case shall it exceed 10 percent by weight of the total dry mix.

510.3 Construction Methods

(1) General

Prior to commencing this Work, all erosion control and tree protection measures required shall be in place and all utilities located and protected. Clearing the site shall conform to Item No. 102, "Clearing and Grubbing". Maintenance of environmental quality protection shall comply with all requirements of the Contract and Item No. 601, "Salvaging and Placing Topsoil".

The Contractor shall conduct his Work such that a reasonable minimum of disturbance to existing utilities will result. Particular care shall be exercised to avoid the cutting or breakage of all existing utilities. If at any time the Contractor damages the utilities in place through his operations, the Contractor shall immediately notify the owner of the utility to make the necessary repairs. When active wastewater sewer lines are cut in the trenching operations, temporary flumes shall be provided across the trench while open and the lines shall be restored when the backfilling has progressed to the original bedding lines of the sewer so cut.

The Contractor shall inform utility owners sufficiently in advance of the Contractor's operations to enable such utility owners to reroute, provide temporary detours or to make other adjustments to utility lines in order that the
Contractor may proceed with his Work with a minimum of delay and expense. The Contractor shall cooperate with all utility owners concerned in effecting any utility adjustments necessary and shall not hold the Owner/Developer liable for any expense due to delay or additional Work because of conflicts arising from existing utilities.

The Contractor shall do all trenching in accordance with the provisions and the directions of the Engineer or designated representative as to the amount of trench left unfilled at any time. All excavation and backfilling shall be accomplished as indicated and in compliance with State Statutes.

Where excavation for a pipeline is required in an existing City street, a street cut permit is required and control of traffic shall be as indicated in accordance with the Texas Manual on Uniform Traffic Control Devices.

Wherever existing utility branch connections, sewers, drains, conduits, ducts, pipes or structures present obstructions to the grade and alignment of the pipe, they shall be permanently supported, removed, relocated or reconstructed by the Contractor through cooperation with the owner of the utility, structure or obstruction involved. In those instances where their relocation or reconstruction is impractical, a deviation from line and grade will be ordered by the Engineer or designated representative and the change shall be made in the manner directed.

Adequate temporary support, protection and maintenance of all underground and surface utility structures, drains, sewers and other obstructions encountered in the progress of the Work shall be furnished by the Contractor, at his expense and as approved by the Engineer or designated representative.

Where traffic must cross open trenches, the Contractor shall provide suitable bridges. For trenches less than 2 feet in width, sheet steel plates having a minimum thickness of 1/2 inch shall be used. For trenches up to 4 feet in width, sheet steel plates having a minimum thickness of 3/4 inches shall be used. In all cases, the plates shall overlay the top of the trench a minimum of 18 inches on both sides and be secured by asphalt. Adequate provisions shall be made for the flow of sewers; drains and watercourses encountered during construction and any structures, which may have been disturbed, shall be satisfactorily restored upon completion of Work.

When rainfall or runoff is occurring or is forecast by the U.S. Weather Service, the Contractor shall not perform or attempt any excavation or other earth moving Work in or near the flood plain of any stream or watercourse or on slopes subject to erosion or runoff, unless given specific approval by the Engineer or designated representative. When such conditions delay the Work, an extension of time will be allowed in accordance with conditions contained in the Contract.

(2) Water Line/New Wastewater Line Separation

Installation of new water or wastewater lines shall conform to the following: Where feasible, water and wastewater lines shall be no closer to each other than 9 feet between outside diameters in all directions and shall be in separate trenches.
If the 9 foot separation cannot be achieved, any portion of a new gravity wastewater line within 9 feet in any direction (between OD's) of a potable water line, shall be in a separate trench and constructed of material (pipe and joints) with a rating of 150 psi minimum.

If the lines are parallel, they shall not be closer than 4 feet horizontally or 2 feet vertically between OD's with the wastewater lower than the water line. If the lines cross, they may be no closer than 6 inches vertically between OD's with the sewer below the water line and one standard 20 foot joint of 150 psi rated wastewater pipe shall be centered at the point of crossing the water line.

Unless wastewater manholes and the connection to the sewer can be made completely watertight and tested for no leakage, they must be installed so as to provide a minimum of 9 feet of horizontal clearance from an existing or proposed water line.

(3) Utility and Storm Sewer Crossings

When the Contractor installs a pipe that crosses under a utility structure or storm sewer and the top of the pipe is within 18 inches of the bottom of the utility structure, the pipe shall be encased as specified in Item No. 505, "Concrete Encasement and Encasement Pipe", for a distance of at least 1 foot on either side of the ditch line of the utility structure or the storm sewer. Unless otherwise specified by the Engineer or designated representative, concrete encasement will not be required for ductile iron, AWWA C-900 (SDR-18) 150 psi rated PVC in sizes to 12 inch, or AWWA C-905 (SDR-25) 165 psi rated PVC in sizes larger than 12 inches. When the Contractor installs a pipe that crosses over a utility structure or storm sewer and the top of the utility structure or storm sewer is within 18 inches of the bottom of the pipe, the pipe shall be either ductile iron, AWWA C-900 (SDR-18) 150 psi rated PVC in sizes to 12 inch, or AWWA C-905 (SDR-25) 165 psi rated PVC in sizes larger than 12 inches, unless otherwise specified by the Engineer or designated representative..

Where trenches wider than 12 inches cross under existing wastewater lines, the sewer lines shall be replaced with one 20 foot joint of ductile iron, AWWA C-900 (SDR-18) 150 psi rated PVC in sizes to 12 inch, or AWWA C-905 (SDR-25) 165 psi rated PVC in sizes larger than 12 inches, centered over the trench.

(4) Trench Excavation

Underground piped utilities shall be constructed in an open cut in accordance with Federal regulations, applicable State Statutes and conforming to Item No. 509, "Trench Safety Systems" and with a trench width and depth described below. When pipe is to be constructed in fill above the natural ground, Contractor shall construct embankment to an elevation not less than one foot above the top of the pipe, after which trench is to be excavated. Required vertical sides shall be sheeted and braced as indicated to maintain the sides of the required vertical excavation throughout the construction period. Adequacy of the design of sheeting and bracing shall be the responsibility of the Contractor's design professional. The Contractor shall be responsible for installation as indicated.
After the pipe has been laid and the backfill placed and compacted to 12 inches above the top of the pipe, any sheeting, shoring and bracing required may be removed with special care to insure that the pipe is not disturbed. As each piece of sheeting is removed, the space left by its removal must be thoroughly filled and compacted with suitable material and provisions made to prevent the sides of the trench from caving until the backfill has been completed. Any sheeting left in place will not be paid for and shall be considered subsidiary to the pipe item bid.

(5) Trench Width

Trenches for water and wastewater lines shall have a clear width on each side beyond the outside surfaces of the pipe bell or coupling of not less than 6 inches nor more than 12 inches.

Trenches for Storm Sewers up to 42 inches shall have a width of 1 foot on each side beyond the outside surfaces of the pipe. Pipes more than 42 inches shall have a trench width of 18 inches on each side beyond the outside surfaces of the pipe.

If the trench width within the pipe zone exceeds widths above, the entire pipe zone shall be refilled with approved backfill material, thoroughly compacted to a minimum of 95 percent of maximum density as determined by TxDOT Test Method Tex-114-E and then re-excavated to the proper grade and dimensions. Excavation along curves and bends shall be so oriented that the trench and pipe are approximately centered on the centerline of the curve, using short lengths of pipe and/or bend fittings if necessary.

For all utilities to be constructed in areas to be filled above natural ground, the embankment shall first be constructed to an elevation not less than 1 foot above the top of the utility after which excavation for the utility shall be made.

(6) Trench Depth and Depth of Cover

All pipe and in-line appurtenances shall be laid to the grades indicated. The depth of cover shall be measured from the established finish grade, natural ground surface (if natural grade is to remain), subgrade for staged construction, street or other permanent surface to the top or uppermost projection of the pipe.

(a) Where not otherwise indicated, all water piping shall be laid to the following minimum depths:

1. Water piping installed in unpaved areas shall be laid with at least 42 inches of cover.

2. Water piping installed in existing streets, roads or other traffic areas shall be laid with at least 48 inches of cover below finish grade.

3. Unless approved by the Engineer or designated representative, installation of water piping in proposed new streets or traffic areas will not be permitted until paving and drainage plans have been approved and the roadway traffic areas excavated to the specified or standard paving subgrade, with all parkways and sidewalk areas
graded according to any applicable provisions of the drainage plans or sloped upward from the curb line to the right of way line at a minimum slope of 1/4 inch per foot. Piping and appurtenances installed in such proposed streets shall be laid with at least 30 inches of cover below the actual subgrade.

(b) Where not otherwise indicated, all wastewater piping shall be laid to the following minimum depths:

1. Wastewater piping installed in unpaved areas shall be laid with at least 48 inches of cover.
2. Wastewater piping installed in existing streets, roads or other traffic areas shall be laid with at least 66 inches of cover.
3. Wastewater piping installed in proposed streets or traffic areas shall be laid with at least 48 inches of cover below the actual subgrade.

(7) Classification of Excavation

Excavation will not be considered or paid for as a separate item of Work, therefore excavated material will not be classified as to type or measured as to quantity. Full payment for all excavation required for the construction shall be included in the various unit or lump sum Contract prices for the various items of Work installed, complete in place. No extra compensation, special treatment or other consideration will be allowed due to rock, pavement, caving, sheeting and bracing, falling or rising water, working under and in the proximity of trees or any other handicaps to excavation.

(8) Dewatering Excavation

Underground piped utilities shall not be constructed or the pipe laid in the presence of water. All water shall be removed from the excavation prior to the pipe placing operation to insure a dry firm granular bed on which to place the underground piped utilities and shall be maintained in such unwatered condition until all concrete and mortar is set. Removal of water may be accomplished by bailing, pumping or by a well-point installation as conditions warrant.

In the event that the excavation cannot be dewatered to the point where the pipe bedding is free of mud, a seal shall be used in the bottom of the excavation. Such seal shall consist of Class B concrete, conforming to Item No. 403, "Concrete for Structures", with a minimum depth of 3 inches.

(9) Trench Conditions

Before attempting to lay pipe, all water, slush, debris, loose material, etc., encountered in the trench must be pumped or bailed out and the trench must be kept clean and dry while the pipe is laid and backfilled. Where needed, sump pits shall be dug adjoining the trench and pumped as necessary to keep the excavation dewatered.

Backfilling shall closely follow pipe laying so that no pipe is left exposed and unattended after initial assembly. All open ends, outlets or other openings in the
pipe shall be protected from damage and shall be properly plugged and blocked watertight to prevent the entrance of trench water, dirt, etc. The interior of the pipeline shall at all times be kept clean, dry and unobstructed.

Where the soil encountered at established footing grade is a quicksand, saturated or unstable material, the following procedure shall be used unless other methods are indicated:

All unstable soils shall be removed to a depth of a minimum 2 feet below bottom of piped utility or as required to stabilize the trench foundation. Such excavation shall be carried out for the entire trench width.

All unstable soil so removed shall be replaced with a concrete seal, foundation rock or coarse aggregate materials placed across the entire trench width in uniform layers not to exceed 6 inches, loose measure and compacted by mechanical tamping or other means which shall provide a stable foundation for the utility.

Forms, sheathing and bracing, pumping, additional excavation and backfill required in unstable trench conditions shall be subsidiary to pipe bid.

(10) Blasting
All blasting shall conform to the provisions of the Contract and applicable local and state codes.

(11) Removing Old Structures
When out of service masonry structures or foundations are encountered in the excavation, such obstructions shall be removed for the full width of the trench and to a depth of 1 foot below the bottom of the trench. When abandoned inlets or manholes are encountered and no plan provision is made for adjustment or connection to the new sewers, such manholes and inlets within the construction limits shall be removed completely to a depth 1 foot below the bottom of the trench. In each instance, the bottom of the trench shall be restored to grade by backfilling and compacting by the methods provided above. Where the trench cuts through storm or wastewater sewers which are known to be abandoned, these sewers shall be cut flush with the sides of the trench and blocked with a concrete plug in a manner satisfactory to the Engineer or designated representative. When old structures are encountered, which are not visible from the existing surface and are still in service, they shall be protected and adjusted as required to the finished grade.

(12) Lines and Grades
Grades, lines and levels shall conform to the Drawings. Any damage to the above by the Contractor shall be re-established at the Contractor's expense. The Contractor shall furnish copies of all field notes and "cut sheets" to the City.

The location of the lines and grades indicated may be changed only by direction of the Engineer or designated representative and it is understood that the Contractor will be paid on the basis of his unit Contract prices bid for such Work.
actually performed and shall make no claim for damages or loss of anticipated
profits due to the change of location or grade.

The Contractor shall furnish, at his expense, all necessary batter boards or
electronic devices for controlling the Work. Batter boards shall be of adequate
size and material and shall be supported substantially. The boards and all
location stakes must be protected from possible damage or change of location.
The Contractor shall furnish good, sound twilled lines for use in achieving lines
and grades and the necessary plummetts and graduated poles.

The Contractor shall submit to the Engineer or designated representative at least
6 copies of any layout Drawings from the pipe manufacturer for review and
approval. The Contractor shall submit the layout Drawings at least 30 days in
advance of any actual construction of the project. The Engineer or designated
representative will forward all comments of the review to the Contractor for
revision. Revisions shall be made and forwarded to the Engineer or designated
representative for his acceptance. Prior to commencement of the Project,
reviewed layout Drawings will be sent to the Contractor marked for construction.

Should the Contractor's procedures not produce a finished pipe placed to grade
and alignment, the pipe shall be removed and relayed and the Contractors
procedures modified to the satisfaction of the Engineer or designated
representative. No additional compensation shall be paid for the removal and
relaying of pipe required above.

(13) Surplus Excavated Materials

Excess material or material which cannot be made suitable for use in
embankments will be declared surplus by the Engineer or designated
representative and shall become the property of the Contractor to dispose of off
site at a permitted fill site, without liability to the City or any individual. Such
surplus material shall be removed from the Work site promptly following the
completion of the portion of the utility involved.

(14) Pipe Bedding Envelope

Pipe shall be installed in a continuous bedding envelope of the type shown on
the drawings or as described herein. The envelope shall extend the full trench
width, to a depth of 6 inches below the pipe and shall rise at least to the top of
storm water pipe and to 12 inches above water and wastewater pipe.

(a) Standard Bedding Materials
<table>
<thead>
<tr>
<th>USE / PIPE MATERIAL</th>
<th>Cement Stabilized Backfill</th>
<th>Natural or Mf'd Sand</th>
<th>Pea Gravel</th>
<th>PIPE BEDDING STONE</th>
</tr>
</thead>
<tbody>
<tr>
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<td></td>
<td></td>
<td>Uncrushed Gravel</td>
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<td>Crushed Gravel</td>
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<td>Stone Screenings</td>
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<tr>
<td>WATER</td>
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<tr>
<td>Welded Steel</td>
<td>X</td>
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<tr>
<td>Service Tubing 3/4&quot; to 2-1/2&quot;</td>
<td>X</td>
<td>X</td>
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<tr>
<td>WATER and WASTEWATER</td>
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<td>Up to 15 Inch ID</td>
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<td>Larger Than 15 Inch ID</td>
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<tr>
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<tr>
<td>Concrete</td>
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<td>X</td>
<td>X</td>
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</tr>
<tr>
<td>Metal</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

(b) General requirements and limitations governing bedding selection.

1. Crushed gravel or crushed stone shall not be used with polyethylene tubing or polyethylene film wrap.

2. Uncrushed gravel may be used with polyethylene film wrap in trenches up to 6 feet deep and in deeper trenches where ample trench width, a tremmie, or conditions will allow controlled placement of the gravel without damaging the polyethylene wrap.

3. Bedding shall be placed in lifts not exceeding 8 inches loose thickness and compacted thoroughly to provide uniform support for the pipe barrel and to fill all voids around the pipe.

4. Pea Gravel or bedding stone shall be used in blasted trenches.

(c) Requirements to prevent particle migration.

Bedding material shall be compatible with the materials in the trench bottom, walls and backfill so that particle migration from, into or through the bedding is minimized. The Engineer or Designated representative may require one or more of the following measures to minimize particle migration: use of impervious cut-off collars; selected bedding materials, such as pea gravel or bedding stone mixed with sand; filter fabric envelopment of the bedding; cement stabilized backfill; or other approved materials or methods. Measures to minimize particle migration will be shown on the Drawings or designated by the Engineer or designated representative, and, unless provisions for payment are provided in the contract documents, the cost of these measures shall be agreed by change order. The following limitations shall apply.
(1) Sand, alone, shall not be used in watercourses, in trenches where groundwater is present, or in trenches with grades greater than 5 percent.

(2) Pea gravel or bedding stone, alone, shall not be used in the street right-of-way within 5 feet of subgrade elevation in trenches that are 3 feet or wider.

(3) Pea gravel or bedding stone, alone, shall not be used where the trench bottom, sides, or backfill is composed of non-cementitious, silty or sandy soils having plasticity indices less than 20, as determined by the Engineer or designated representative.

(15) Laying Pipe

No pipe shall be installed in the trench until excavation has been completed, the bottom of the trench graded and the trench completed as indicated.

Laying of corrugated metal pipes on the prepared foundation shall be started at the outlet end with the separate sections firmly joined together, with outside laps of circumferential joints pointing upstream and with longitudinal laps on the sides. Any metal in joints, which is not protected by galvanizing, shall be coated with suitable asphaltum paint. Proper facilities shall be provided for hoisting and lowering the sections of pipe into the trench without damaging the pipe or disturbing the prepared foundation and the sides of the trench. Any pipe which is not in alignment or which shows any undue settlement after laying or damage, shall be taken up and re-laid without extra compensation.

Multiple installations of corrugated pipe or arches shall be laid with the centerlines of individual barrels parallel. When not otherwise indicated, clear distances of 2 feet between outer surfaces of adjacent pipes shall be maintained.

No debris shall remain in the drainways or drainage structures.

All recommendations of the manufacturer shall be carefully observed during handling and installation of each material. Unless otherwise indicated, all materials shall be delivered to the project by the manufacturer or agent and unloaded as directed by the Contractor. Each piece shall be placed facing the proper direction near to where it will be installed.

The interior of all pipe, fittings and other accessories shall be kept free from dirt and foreign matter at all times and stored in a manner that will protect them from damage. Stockpiled materials shall be stacked so as to minimize entrance of foreign matter.

The interior of all pipeline components shall be clean, dry and unobstructed when installed.

Piping materials shall not be skidded or rolled against other pipe, etc. and under no circumstances shall pipe, fittings or other accessories be dropped or jolted.

During handling and placement, materials shall be carefully observed and inspected and any damaged, defective or unsound materials shall be marked,
rejected and removed from the job site. Minor damage shall be marked and repaired in a manner satisfactory to the Engineering or designated representative. Joints, which have been placed, but not joined, backfilled, etc., shall be protected in a manner satisfactory to the Engineer or designated representative.

(16) Assembling of Pipe

Angular spacing of all joints shall meet the manufacturer's recommendations for the pipe and accessories being used. Side outlets shall be rotated so that the operating stems of valves shall be vertical when the valves are installed. Pressure pipe shall be laid with bell ends facing the direction of pipe installation. Pipe end bells shall be placed upgrade for all wastewater lines.

Orientation marks, when applicable, shall be in their proper position before pipe is seated.

Before joining any pipe, all foreign matter, lumps, blisters, excess coal tar coating, oil or grease shall be removed from the ends of each pipe and the pipe ends shall then be wire brushed and wiped clean and dry. Pipe ends shall be kept clean until joints are made.

Every precaution shall be taken to prevent foreign material from entering the pipe during installation. No debris, tools, clothing or other materials shall be placed in the pipe.

(17) Joints

(a) Mortar (Storm Drain joints only)

Pipe ends shall be clean, free of asphalt or other contaminants, which will inhibit the bond of the mortar to the pipe. The pipe ends shall be moistened immediately prior to placing the mortar in the joint.

b) Cold Applied Preformed Plastic Gaskets (Storm Drain joints only)

The pipe ends shall be clean and the joint material applied to the dry pipe. In cold weather, the joint material shall be heated to facilitate the seal of the joint.

(c) O-Ring and Push-on Joints

Just before making a joint the ends of the pipe shall be clean, dry, free of any foreign matter, lump blisters, excessive coal tar coating and grease or oil and shall be wire brushed. The gasket and the inside surface of the bell shall be lubricated with a light film of soft vegetable soap compound (Flax Soap) to facilitate telescoping the joints. The rubber gasket if not factory installed shall be stretched uniformly as it is placed in the spigot groove to insure a uniform volume of rubber around the circumference of the groove. The spigot shall be centered in the bell, the pipe pushed home uniformly and brought into true alignment. Bedding material shall be placed and tamped against pipe to secure the joint. Care should be taken to prevent dirt or foreign matter from entering the joint space.
(d) Bolted Joints

All flanged, mechanical or other bolted joints shall be joined with nuts and bolts and be coated as indicated above in Iron Pipe.

(18) Pressure Pipe Laying

(a) Grout for Concrete Steel Cylinder Pipe (CSC) and Welded Steel Pipe

Aggregate, cement, etc., shall be as indicated in "Mortar" herein.

Grout shall be poured into the recess between the bell and spigot on the outside of the pipe and contained by a joint wrapper ("diaper") recommended by the pipe manufacturer. The wrapper shall have a minimum width of 7 inches for 30 inch and smaller and 9 inches for larger pipe, secured to the pipe by "Band Iron" steel straps. The grout shall be poured in one continuous operation in such manner that after shrinkage and curing the joint recess shall be completely filled.

Mortar for the inside recess shall be of the consistency of plaster. The inside recess between the bell and spigot shall be filled with mortar after the pipe joint on either side of the recess has been backfilled and well tamped with no less than one pipe joint installed ahead of the pipe forming the recess. The mortar shall completely fill the recess and shall be trowelled and packed into place and finished off smooth with the inside of the pipe.

The Contractor shall inspect the joint after the mortar has set and make repairs of any pockets, cracks or other defects caused by shrinkage to the satisfaction of the Engineer or designated representative. The inside surface shall be cleared of any mortar droppings, cement, water, slurry, etc., before they have become set and shall be cleared of any other foreign matter. The inside surface of the pipe shall be left clean and smooth.

Pipe shall be handled at all times with wide non abrasive slings, belts or other equipment designed to prevent damage to the coating and all such equipment shall be kept in such repair that its continued use is not injurious to the coating. The use of tongs, bare pinch-bars, chain slings, rope slings without canvas covers, canvas or composition belt slings with protruding rivets, pipe hooks without proper padding or any other handling equipment, which the Engineer or designated representative deems to be injurious to the coating, shall not be permitted. The spacing of pipe supports required to handle the pipe shall be adequate to prevent cracking or damage to the cement mortar lining.

(19) Placing Pipe in Tunnels and Encasements

Piping installed as a carrier pipe in a tunnel, encasement pipe, etc., shall have uniform alignment, grade, bearing and conform to the reviewed Shop Drawings. All necessary casing spacers, bedding material, grout cradle or paving, bracing, blocking, etc., as stipulated by the Contract or as may be required to provide and
maintain the required pipe alignment and grade, shall be provided by the Contractor at no cost except as provided by the Bid Items. This shall include casing spacers acceptable to the City Round Rock attached to the carrier pipe in accordance with the manufacturer’s recommendations. The insertion pushing forces shall not exceed the pipe manufacturer’s recommendation. Such carrier piping shall have flexible bolted or gasketed push-on joints or Concrete Steel Cylinder pipe installed as follows:

(a) 21 Inch Pipe and Smaller

Prior to placing the pipe in the tunnel, the inside joint recess at the bell shall be buttered with cement mortar.

After the joint is engaged, the excess mortar shall be smoothed by pulling a tight fitting swab through the joint. Cement mortar protection shall then be placed in the normal manner to the exterior of the joint and allowed to harden sufficiently to avoid dislodgment during installation. If time is of the essence, a quick setting compound may be used.

(b) 24 Inch Pipe and Larger

Each length of pipe shall be pushed into the tunnel as single units. A flexible mastic sealer shall be applied to the exterior of the joint prior to joint engagement. The surfaces receiving the mastic sealer shall be cleaned and primed in accordance with the manufacturer’s recommendation. Sufficient quantities of the mastic sealer shall be applied to assure complete protection of all steel in the joint area. The interior of the joint shall be filled with cement mortar in the normal manner after the pipe is in its final position within the tunnel.

(20) Temporary Pipe Plugs, Caps, Bulkheads and Trench Caps

Temporary plugs, caps or plywood bulkheads shall be installed to close all openings of the pipe and fittings when pipeline construction is not in progress.

All temporary end plugs or caps shall be secured to the pipe as provided under Item No. 507, "Bulkheads".

Trench caps shall be reinforced Class D concrete as indicated.

(21) Corrosion Control

(a) Protective Covering

Unless otherwise indicated, all flanges, nuts, bolts, threaded outlets and all other iron or steel components buried and in contact with earth or backfill shall be wrapped with 8-mil (minimum) polyethylene film meeting ANSI/AWWA C-105 to provide a continuous wrap.

(22) Pipe Anchorage, Support and Protection

Pressure pipeline tees, plugs, caps and bends 22-1/2 degrees and more and other bends as directed shall be securely anchored by suitable concrete thrust blocking or by approved metal harness. Unless otherwise indicated, on 24 inch or
larger piping, all bends greater than 11 1/4 degrees shall be anchored as described herein.

Storm sewers on steep grades shall be lugged as indicated.

(a) Concrete Thrust Blocking

Concrete for use as reaction or thrust blocking shall be Class B conforming to Item No. 403, "Concrete for Structures".

Concrete blocking shall be placed between solid ground and the fitting to be anchored. The area of bearing on the pipe and on the ground shall be as indicated or directed by the Engineer or designated representative. The blocking shall, unless otherwise indicated, be so placed that the pipe, fittings and joints will be accessible for repair.

The trench shall be excavated at least 6 inches outside the outermost projections of the pipe or appurtenance and the trench walls shaped or undercut according to the detail Drawings or as required to provide adequate space and bearing area for the concrete.

The pipe and fittings shall be adequately weighted and laterally braced to prevent floating, shifting or straining of the pipeline while the concrete is being placed and taking initial set. The Contractor shall be solely responsible for the sufficiency of such restraints.

(b) Metal Thrust Restraint

Fabricated thrust restraint systems such as those described below may be approved for use instead of concrete blocking. To obtain approval, the project Drawings must include sufficient drawings, notes, schedules, etc., to assure that the proposed restraints as installed will be adequate to prevent undesirable movement of the piping components. Such restraint systems may only be used where and as specifically detailed and scheduled on approved Project Drawings.

1. Thrust Harness

A metal thrust harness of tie rods, pipe clamps or lugs, turnbuckles, etc., may be approved. All carbon steel components of such systems, including nuts and washers, shall be hot-dip galvanized; all other members shall be cast ductile iron. After installation, the entire assembly shall be wrapped with 8-mil polyethylene film, overlapped and taped in place with duct tape to form a continuous protective wrap.

2. Restrained Joints

Piping or fitting systems utilizing integral mechanically restrained joints may be approved. All components of such systems shall be standard manufactured products fabricated from cast ductile iron, hot-dip galvanized steel, brass or other corrosion resistant materials and the entire assembly shall be protected with a continuous film wrap as described for 1. above.
Location, configuration and description of such products shall be specifically detailed on the Drawings. (Add-on attachments such as retainer glands, all-thread rods, etc., are not acceptable.)

(c) Concrete Encasement, Cradles, Caps and Seals
When trench foundation is excessively wet or unstable or installation of water or wastewater pipe will result in less than 30 inches of cover, Contractor shall notify the Engineer or designated representative. The Engineer or designated representative may require Contractor to install a concrete seal, cradle, cap, encasement or other appropriate action.

All concrete cap, etc., shall be continuous and begin and end as specified. Concrete cap, cradle and encasement shall conform to the Drawings. The pipe shall be well secured to prevent shifting or flotation while the concrete is being placed.

(d) Anchorage Bulkheads
Concrete bulkheads keyed into the undisturbed earth shall be placed as indicated to support and anchor the pipe and/or backfill against end thrust, slippage on slopes, etc. Concrete material and placement shall be Class A, Item No. 403, "Concrete for Structures".

(e) Trench Caps, Concrete Rip-Rap and Shaped Retards
Where called for by the Contract or as directed by the Engineer or designated representative, concrete trench caps, concrete rip-rap and/or shaped retards shall be placed as detailed by the Drawings as protection against erosion. Concrete material and placement shall be Class B, Item No. 403, "Concrete for Structures".

(23) Wastewater Connections

(a) Connections to Mains 12 Inches and Smaller
All branch connections of new main lines shall be made by use of manholes.

Service stubs shall be installed as indicated. Minimum grade shall be 1 percent downward to main and minimum cover shall be 4 1/2 feet at the curb. Standard plugs shall be installed in the dead end before backfilling.

Where a service connection to a main 12 inches or smaller is indicated, a sanitary tee or double wye shall be installed.

Where a service connection to a main 15 inches or larger is indicated, a field tap may be made with the pipes installed crown to crown. The tap should be made conforming to the pipe manufacturer’s recommendations with the Engineer or designated representative’s approval.

Where not otherwise indicated, (wastewater) service connections shall be installed so that the outlet is at an angle of not more than 45 degrees above horizontal at the main line.
(b) Connections to the Existing System

Unless otherwise specified by the Engineer or designated representative, all connections made to existing mains shall be made at manholes with the crown of the inlet pipe installed at the same elevation as the crown of the existing pipe. Service stubs installed on the existing system shall be installed by use of tapping saddles unless otherwise approved by the Engineer or designated representative. Extreme care shall be exercised to prevent material from depositing in the existing pipe as the taps are being made.

When connections to existing mains are made, a temporary plug approved by the Engineer or designated representative must be installed downstream in the manhole to prevent water and debris from entering the existing system before Final Completion. These plugs shall be removed after the castings are adjusted to finish grade or prior to Final Completion.

(24) Water System Connections

The Contractor shall, at his expense, make all necessary connections of new piping or accessories to the existing water system. To minimize any inconvenience from outages, the Contractor shall schedule all such connections in advance and such schedule must be approved by the Engineer or designated representative before beginning any Work.

(a) Shutoffs

The City will make all shutoffs on existing water mains. The Contractor shall be required to notify the Engineer or designated representative on the job at least 72 hours prior to the desired time for any shutoff. The Engineer or designated representative will notify any affected utility customers at least 24 hours prior to the shutoff. The Water Utility will make the shutoff after ensuring that all appropriate measures have been taken to protect the water system, customers and employees.

The City will operate all valves to fill existing mains. Where a newly constructed main has not been placed in service and has only one connection to the public water supply, the Contractor may operate one valve to fill the main after approval has been obtained from the Water Utility. The operation of the valve is to be conducted under the immediate supervision of the Engineer or designated representative.

Water for the Work shall be metered and furnished by the Contractor in accordance with Section 01500 of the Standard Contract Documents.

(b) Wet Connections to Existing Water System

The Contractor shall make all wet connections called for by the Contract or required to complete the Work. Two connections to an existing line performed during the same shutout, at the same time and at a distance less than 50 linear feet apart, will be considered one wet connection. Two connections to an existing line performed during the same shutout, at the
same time and at a distance equal to, or greater than 50 linear feet will be considered two wet connections. A wet connection shall include draining and cutting into existing piping and connecting a new pipeline or other extension into the existing pressure piping, forming an addition to the water transmission and distribution network.

The Contract price for wet connections shall be full payment for all necessary shutoffs, excavation, removing plugs and fittings, pumping water to drain the lines, cutting in new fittings, blocking and anchoring piping, bedding and backfilling, placing the lines and service and all site cleanup.

No water containing detectable amounts of chlorine may be drained, released or discharged until specific planning and appropriate preparations to handle, dilute and dispose of such chlorinated water are approved in advance by the City and the disposal operations will be witnessed by an authorized representative from the City.

(c) Pressure Taps to Existing Water System

The Contractor shall make all pressure taps called for by the Contract Documents or required to complete the Work. A pressure tap shall consist of connecting new piping to the existing water system by drilling into the existing pipe while it is carrying water under normal pressure without taking the existing piping out of service.

Unless otherwise provided by the Contract, the Contractor shall, at his expense, perform all necessary excavation, furnish and install the tapping sleeve, valve and accessories, provide the tapping machine, drill the tap and shall block, anchor and backfill the piping, valve and all accessories, place the new piping in service and perform all site cleanup. When the City makes the tap, City forces are not obligated or expected to perform any Work except to provide tapping machine and drill the actual hole. If City crews are to make the tap, fiscal arrangements must be made in advance at the Taps Office, Waller Creek Center, 625 East 10th Street.

If a private Contractor makes the tap, a W-WW Inspector must be present. "Size on size" taps will not be permitted, unless made by use of an approved full circle gasket tapping sleeve. Concrete blocking shall be placed behind and under all tap sleeves 24 hours prior to making the wet tap.

(d) Service Connections

Service connection taps into PVC or AC pipe or into CI or DI pipe 12 inches or smaller shall be made using either a service clamp or saddle or a tapping sleeve as recommended by the pipe manufacturer and as approved by the Engineer or designated representative. Direct tapping of these pipes will not be permitted.

All water service connections shall be installed so that the outlet is at an angle of not more than 45 degrees above horizontal at the main line.
Precautions should be taken to ensure that the tapping saddle or sleeve is placed on the pipe straight to prevent any binding or deformation of the PVC pipe. The mounting chain or U-bolt strap must be tight.

Tapping shall be performed with a sharp shell type cutter so designed that it will smoothly penetrate heavy walled PVC DR14 and 200 psi AC and will retain and extract the coupon from the pipe.

(25) Backfilling

(a) General

Special emphasis is placed upon the need to obtain uniform density throughout the backfill material. The maximum lift of backfill shall be determined by the compaction equipment selected and in no case shall it exceed 18 inches, loose measurement.

No heavy equipment, which might damage pipe, will be allowed over the pipe until sufficient cover has been placed and compacted. All internal pipe bracing installed or recommended by the manufacturer shall be kept in place until the pipe bedding and trench backfill have been completed over the braced pipe section. Testing of the completed backfill in streets and under and around structures shall meet the specified density requirements. Initial testing shall not be at Contractor's expense and shall conform to the "General Conditions."

(b) General Corrugated Metal Pipe

After the corrugated metal pipe structure has been completely assembled on the proper line and grade and headwalls constructed where indicated; selected material free from rocks over 8 inches in size from excavation or borrow, as approved by the Engineer or designated representative, shall be placed along both sides of the completed structures equally, in uniform layers not exceeding 6 inches in depth (loose measurement), sprinkled if required and thoroughly compacted between adjacent structures and between the structures and the sides of the trench.

Backfill material shall be compacted to the same density requirements as indicated for the adjoining sections of embankment in accordance with the governing specifications thereof. Above the 3/4 point of the structure, the fill shall be placed uniformly on each side of the pipe in layers not to exceed 12 inches, loose measure.

Prior to adding each new layer of loose backfill material, until a minimum of 12 inches of cover is obtained over the crown of the pipe, an inspection will be made of the inside periphery of the corrugated metal structure to determine if any floating, local or unequal deformation has occurred as a result of improper construction methods.

(c) Backfill Materials

The Engineer or designated representative may approve any of the following well graded materials:
1. Select trench material
2. Sand
3. Crushed rock cuttings
4. Rock cuttings
5. Foundation Rock
6. Blasted material with fines and rock
7. Cement stabilized material
8. Borrow

Within the 100-year flood plain, sand will not be permitted for backfilling. The Engineer or designated representative will approve the topsoil for areas to be seeded or sodded.

(d) Backfill in Street Right of Way

Placement of backfill under existing or future pavement structures and within 2 feet of any structures shall be compacted to the required density using any method, type and size of equipment, which will give the required compaction without damaging the pipe or bedding. Placement of backfill greater than 2 feet beyond structures in Right of Way shall be conform to (g) below. The depth of layers, prior to compaction, shall depend upon the type of sprinkling and compacting equipment used and the test results thereby obtained. Prior to and in conjunction with the compaction operation, each layer shall be brought to the moisture content necessary to obtain the required density and shall be kept level to insure uniform compaction over the entire layer. Testing for density shall be in accordance with Test Method Tex-114-E and Test Method Tex-115-E.

Each layer of backfill must provide the density as required herein. Swelling soils (soils with plasticity index of 20 or more) shall be sprinkled as required to provide not less than optimum moisture nor more than 2 percent over optimum moisture content and compacted to the extent necessary to provide not less than 95 percent nor more than 102 percent of the density as determined in accordance with Test Method Tex-114-E. Non-swelling soils (soils with plasticity index less than 20) shall be sprinkled as required and compacted to the extent necessary to provide not less than 95 percent of the density as determined in accordance with Test Method Tex-114-E.

After each layer of backfill is complete, tests may be made by the Engineer or designated representative. If the material fails to meet the density indicated, the course shall be reworked as necessary to obtain the indicated compaction and the compaction method shall be altered on subsequent Work to obtain indicated density.

At any time, the Engineer or designated representative may order proof rolling to test the uniformity of compaction of the backfill layers. All irregularities, depressions, weak or soft spots that develop shall be corrected immediately by the Contractor.
Should the backfill, due to any reason, lose the required stability, density or finish before the pavement structure is placed, it shall be recompacted and refinished at the sole expense of the Contractor. Excessive loss of moisture in the subgrade shall be prevented by sprinkling, sealing or covering with a subsequent backfill layer or granular material. Excessive loss of moisture shall be construed to exist when the subgrade soil moisture content is more than 4 percent below the optimum of compaction ratio density. Backfill shall be placed from the top of the bedding material to the existing grade, base course, subgrade or as indicated. The remainder of the street backfill shall be Flexible Base, Concrete or Hot Mix Asphalt Concrete as indicated or to replaced in kind to the surface removed to construct the pipe.

(e) Backfill in County Street or State Highway Right of Way

All Work within the right of way shall meet the requirements of (d) above, as a minimum and shall meet the requirements of the permit issued by the County when their requirements are more stringent. Prior to the start of construction, the Contractor shall be responsible for contacting the appropriate TxDOT office or County Commissioner's Precinct Office and for coordinating his activities with the operating procedures in effect for utility cut permits and pavement repair under their jurisdiction. Approval for all completed Work in the State or County right of way shall be obtained from the appropriate Official prior to final payment by the Owner.

(f) Backfill in Railroad Right of Way

All Work within the railroad right of way shall meet the requirements of (d) above, as a minimum and shall meet the requirements of the permit issued by the Railroad Owner when their requirements are more stringent. Approval for all completed Work in the railroad right of way shall be obtained from the Railroad prior to Final Completion.

(g) Backfill in Easements

Where not otherwise indicated, Contractor may select whatever methods and procedures may be necessary to restore entire Work area to a safe, useful and geologically stable condition with a minimum density of 85 percent or a density superior to that prior to construction.

In and near flood plain of all streams and watercourses, under or adjacent to utilities, structures, etc. all backfill shall be compacted to a density of not less than 95 percent conforming to TxDOT Test Method Tex-114-E, unless otherwise directed by Engineer or designated representative.

All soil areas disturbed by construction shall be covered with top soil and seeded conforming to Item No. 604, "Seeding for Erosion Control". All turf, drainways and drainage structures shall be constructed or replaced to their original condition or better. No debris shall remain in the drainways or drainage structures.
(26) Quality Testing for Installed Pipe

(a) Wastewater Pipe Acceptance Testing

After construction is complete, Engineer or designated representative will determine whether the pipeline is to be tested for infiltration, exfiltration or by the low-pressure air test method. In addition, plastic pipe 18 inches and larger in diameter shall be deflection tested.

Wastewater pipe installed in the City of Round Rock and its ETJ areas shall be tested for exfiltration or infiltration as described below in “Exfiltration Test” and “Infiltration Test” or by acceptable low pressure air test, as described below. At the conclusion of either test series, the Work shall be further tested for pipeline settlement and also for deflection as described below. The Contractor shall be solely responsible for making proper repairs to those elements, which do not pass these test requirements.

(b) Exfiltration Test

Water for the Work shall be metered and furnished by the Contractor in accordance with Section 01500 of the Standard Contract Documents.

The pipeline shall be completely filled with water for its complete length or by sections as determined by the Engineer or designated representative. If tested for its complete length, the maximum head at any point shall not exceed 25 feet unless otherwise indicated. If tested in sections, the manholes in the test section shall be completely filled with water. After the pipeline has been filled and allowed to stand for 24 hours, the amount of exfiltration shall be calculated. Any amount in excess of 200 gallons per inch of inside pipe diameter per mile per day shall be cause for rejection.

For portions of lines located within the Edwards Aquifer Recharge Zone or within any recharge area or recharge feature within the Edwards Aquifer Transition Zone, the minimum head during testing shall not be less than 2 feet and the leakage rate shall not exceed 50 gallons per inch of inside pipe diameter per mile per day. This rate shall apply for the entire portion of the line extending up to the first manhole located outside the recharge zone, recharge area, or recharge features indicated on Drawings and shall also be applicable for any recharge areas or recharge features which may be identified during construction. For construction within the 25-year flood plain, the exfiltration rate shall not exceed 10 gallons per inch diameter per mile of pipe per 24 hours at the same minimum test head.

(c) Infiltration Test

When the pipe placed in easements is completed, the upper portion of the trench backfill shall be removed to a depth of not less than 18 inches below the finished surface and width equal to the original trench width. The trench shall then be flooded with water until it is completely saturated and water stands in the ditch a minimum of 12 inches deep. In cases of steep terrain, earthen dikes shall be used to assure that water will stand.
over the trench. After it is apparent that the trench is completely saturated, the main shall then be inspected with closed-circuit television for infiltration. Any section of the main or any service stub that indicates infiltration above the maximum quantity specified shall be cause for rejection.

This procedure shall not be used for pipes installed in areas where the Plasticity Index (P.I.) of the surrounding material is 20 or higher or where the backfill material has a P.I. of 20 or more.

For portions of lines located within the Edwards Aquifer Recharge Zone or within any recharge area or recharge feature within the Edwards Aquifer Transition Zone, the total infiltration as determined by water test, must be at a rate not greater than 50 gallons per inch of pipe diameter per mile of pipe per 24 hours at a minimum test head of two feet. This rate shall apply for the entire portion of the line extending up to the first manhole located outside the recharge zone, recharge area, or recharge features indicated on Drawings and shall also be applicable for any recharge areas or recharge features which may be identified during construction. For construction within the 25-year flood plain, the infiltration rate shall not exceed 10 gallons per inch diameter per mile of pipe per 24 hours at the same minimum test head.

If the quantity of infiltration exceeds the maximum quantity specified, remedial action must be undertaken in order to reduce the infiltration to an amount within the limits specified.

(d) Pipeline Settlement Test

During the infiltration test or after the exfiltration test, the pipe will be TV inspected for possible settlement. When air testing has been used, water shall be flowed into the pipe to permit meaningful observations. Any pipe settlement which causes excessive ponding of water in the pipe shall be cause for rejection. Excessive ponding shall be defined as a golf ball (1-5/8” dia.) submerged at any point along the line.

(e) Low Pressure Air Test of Plastic Gravity Flow Wastewater Lines

(1) General

Wastewater lines, at the discretion of the Engineer or designated representative, shall be air tested between manholes. Backfilling to grade shall be completed before the test and all laterals and stubs shall be capped or plugged by the Contractor so as not to allow air losses, which could cause an erroneous, test result. Manholes shall be plugged so they are isolated from the pipe and cannot be included in the test.

All plugs used to close the sewer for the air test shall be capable of resisting the internal pressures and must be securely braced. Place all air testing equipment above ground and allow no one to enter a manhole or trench where a plugged sewer is under pressure.
Release all pressure before the plugs are removed. The testing equipment used must include a pressure relief device designed to relieve pressure in the sewer under test at 10 psi or less and must allow continuous monitoring of the test pressures in order to avoid excessive pressure. Use care to avoid the flooding of the air inlet by infiltrated ground water. (Inject the air at the upper plug if possible.) Use only qualified personnel to conduct the test.

(2) Ground Water

Since the presence of ground water will affect the test results, test holes shall be dug to the pipe zone at intervals of not more than 100 feet and the average height of ground water above the pipe (if any) shall be determined before starting the test.

(3) Test Procedure

The Engineer or designated representative may, at any time, require a calibration check of the instrumentation used. Use a pressure gauge having minimum divisions of 0.10 psi and an accuracy of 0.0625 psi. (One ounce per square inch.) All air used shall pass through a single control panel. Clean the sewer to be tested and remove all debris where indicated. Wet the sewer prior to testing. The average back pressure of any groundwater shall be determined (0.433 psi) for each foot of average water depth (if any) above the sewer.

Add air slowly to the section of sewer being tested until the internal air pressure is raised to 4.0 psig greater than the average back pressure of any ground water that may submerge the pipe. After the internal test pressure is reached, allow at least 2 minutes for the air temperature to stabilize, adding only the amount of air required to maintain pressure. After the temperature stabilization period, disconnect the air supply. Determine and record the time in seconds that is required for the internal air pressure to drop from 3.5 psig to 2.5 psig greater than the average backpressure of any ground water that may submerge the pipe. Compare the time recorded with the specification time for the size and length of pipe as given in the following table:
Table For Low Pressure Air Testing of Plastic Pipe:

<table>
<thead>
<tr>
<th>Diameter of Pipe, (in.)</th>
<th>Specification Time (min: sec) for length shown</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>100 ft</td>
</tr>
<tr>
<td>4</td>
<td>3:46</td>
</tr>
<tr>
<td>8</td>
<td>7:34</td>
</tr>
<tr>
<td>18</td>
<td>17:00</td>
</tr>
<tr>
<td>21</td>
<td>19:50</td>
</tr>
</tbody>
</table>

**NOTES:**

1. Specification times are as given in UNI-B-6 RECOMMENDED PRACTICE FOR LOW-PRESSURE TESTING OF INSTALLED PIPE -- by Uni-Bell PVC Pipe Association, 2655 Villa Creek Dr., Ste. 155, Dallas Texas 75234.

2. Pipe Sizes acceptable by City of Round Rock are as given in the Water and Wastewater Utility’s Standard Products List (SPL’s) WW-227 and WW-227A.

Any drop in pressure, from 3.5 psig to 2.5 psig (adjusted for groundwater level), in a time less than that required by the above table shall be cause for rejection. When the line tested includes more than one size pipe, the minimum time shall be that given for the largest size pipe included.

Test procedure for wastewater pipe located in the Edwards Aquifer Recharge Zone or identified recharge areas or recharge features within the Edwards Aquifer Transition Zone:

Low-pressure air tests must conform to the procedure described in ASTM C-924 or other equivalent procedures. For safety reasons, air testing of pipe sections will be limited to line sizes of 36 inches inside diameter or less. Lines that are 36 inches or larger inside diameter may be air tested at each joint. The minimum time allowable for the pressure to drop from 3.5 pounds per square inch to 2.5 pounds per square inch gauge during a joint test, regardless of pipe size, shall be twenty (20) seconds.

For sections of pipe less than 36-inch inside diameter, the minimum time allowable for the pressure to drop from 3.5 pounds per square inch gauge to 2.5 pounds per square inch gauge must be computed by the following equation:
\[ T = 0.0850 \frac{(D)(K)}{(Q)}, \text{ where} \]

\begin{align*}
T &= \text{time for pressure to drop 1.0 pounds per square inch gauge in seconds;} \\
K &= 0.000419(D)(L), \text{ but not less than 1.0} \\
D &= \text{nominal inside diameter in inches;} \\
L &= \text{length of line of same pipe size in feet;} \text{ and} \\
Q &= \text{rate of loss, assume 0.0015 cubic feet per minute per square foot} \\
&\quad (\text{ft}^3/\text{min}/\text{ft sq}) \text{ of internal surface area.}
\end{align*}

Any drop in pressure, from 3.5 psig to 2.5 psig, in a time less than that required by the above formula shall be cause for rejection. When the line tested includes more than one size of pipe, the minimum time shall be that calculated for the largest size pipe included.

Manholes must be tested separately and independently. All manholes must be hydrostatically tested with a maximum loss allowance of 0.025 gallon per foot diameter per foot of head per hour.

When lines are air tested, manholes are to be tested separately by exfiltration or vacuum method (see Standard Specification Item No. 506, “Manholes”).

(f) Deflection Test

Deflection tests shall be performed by the Contractor on all flexible and semi-rigid wastewater pipes. The tests shall be conducted after the final backfill has been in place at least 30 days. Testing for in-place deflection shall be with a pipe mandrel or rigid ball sized at 95% of the inside diameter of the pipe. A second test of flexible and semi-rigid wastewater pipes 18 inch size and larger, also with a pipe mandrel or ball sized at 95% of the inside diameter of the pipe, shall be conducted by the Contractor 30 days prior to expiration of his warranty on the Work.

Contractor shall submit his proposed pipe mandrels or testing balls to the Engineer or his designated representative for concurrence prior to testing the line.

Test(s) must be performed without mechanical pulling devices and must be witnessed by the Engineer or his designated representative.

Any deficiencies noted shall be corrected by the Contractor and the test(s) shall be redone.

(27) Pressure Pipe Hydrostatic Testing

After the pipe has been installed and backfilled and all service laterals, fire hydrants and other appurtenances installed and connected, a pressure test, followed by a leakage test, will be conducted by the City. The City will furnish the pump and gauges for the tests. The Contractor shall be present and shall furnish all necessary assistance for conducting the tests. The specified test pressures will be based on the elevation of the lowest point of the line or section under test. Before applying the specified test pressure, all air shall be expelled from the pipe.
If permanent air vents are not located at all high points, the Contractor shall install corporation cocks at such points.

All drain hydrant and fire hydrant leads, with the main 6-inch gate valve open, the hydrant valve seats closed and nozzle caps open, shall be included in the test.

(a) Pressure Test

The entire project or each valved section shall be tested, at a pressure of 200 psi for a sufficient period (approximately 10 minutes) to discover all leaking or defective materials. Repairs shall be made by the Contractor to correct any leaking or defective materials.

(b) Pressure Pipe Leakage Test

A leakage test will follow the pressure test and be conducted on the entire project or each valved section. The leakage test shall be at 150 psi for at least 1 hour.

(1) Allowable Leakage

Leakage shall be defined as the quantity of water that must be supplied into any test section of pipe to maintain the specified leakage test pressure (see above, "Pressure Pipe Leakage Test") after the air in the pipeline has been expelled and the pipe has been filled with water.

No pipe installation will be accepted if the leakage exceeds 25 gallons/24 hours/mile of pipe/inch nominal pipe diameter.

(25 gpd)  
(in. - mi.)

(2) Location and Correction of Leakage

If such testing discloses leakage in excess of this specified allowable, the Contractor, at his expense, shall locate and correct all defects in the pipeline until the leakage is within the indicated allowance.

All visible leakage in pipe shall also be corrected by Contractor at his own expense.

(28) Service Charges for Testing

Initial testing performed by City forces for the Contractor will be at the City's expense. Retesting, by City forces, of Contractor's work that fails initial testing will be at the Contractor's expense. The City's charge for retests will be $265.00, plus $50.00 for each hour over four hours. On City-funded projects, the charges incurred by the City for retesting will be deducted from funds due the Contractor. On non-City-funded projects, the charges incurred by the City for retesting will be billed to the Contractor. The City will withhold acceptance of the Contractor's work until the Contractor has paid the City for the retesting costs.
(29) Disinfection of Potable Water Lines

(a) Preventing Contamination

The Contractor shall protect all piping materials from contamination during storage, handling and installation. Prior to disinfection, the pipeline interior shall be clean, dry and unobstructed. All openings in the pipeline shall be closed with watertight plugs when pipe laying is stopped at the close of the day’s work.

(b) Cleaning

Prior to disinfection the Contractor shall clean the pipeline to remove foreign matter. For pipelines 16” in diameter or smaller, cleaning shall consist of flushing the pipeline. For pipelines greater than 16” in diameter, cleaning shall be performed by operating hydrants and blow-offs located at low points in the pipeline, or by mechanical means (sweeping or pigging. Water for the Work shall be metered and furnished by the Contractor in accordance with Section 01500 of the Standard Contract Documents.

(c) Procedure and Dosage

The Contractor, at its expense, will supply the test gauges and the Sodium Hypochlorite conforming to ANSI/AWWA B300, which contains approximately 5 percent to fifteen percent available chlorine, and will submit for approval a written plan for the disinfection process. Calcium Hypochlorite conforming to ANSI/AWWA B300, which contains approximately 65 percent available chlorine by weight, may be used in granular form or in 5 g tablets for 16” diameter or smaller lines, if it is included as part of the written plan of disinfection that is approved by the City of Round Rock. The Contractor, at its expense, shall provide all other equipment, supplies and the necessary labor to perform the disinfection under the general supervision of the City.

One connection to the existing system will be allowed with a valve arranged to prevent the strong disinfecting dosage from flowing back into the existing water supply piping. The valve shall be kept closed and locked in a valve box with the lid painted red. No other connection shall be made until the disinfection of the new line is complete and the water samples have met the established criteria. The valve shall remain closed at all times except when filling or flushing the line and must be manned during these operations. Backflow prevention in the form of a reduced pressure backflow assembly must be provided if the valve is left unattended. The new pipeline shall be filled completely with disinfecting solution by feeding the concentrated chlorine and approved water from the existing system uniformly into the new piping in such proportions that every part of the line has a minimum concentration of 50 mg/liter available chlorine.

The disinfecting solution shall be retained in the piping for at least 24 hours and all valves, hydrants, services, stubs, etc. shall be operated so
as to disinfect all their parts. After this retention period, the water shall contain no less than 25 mg/liter chlorine throughout the treated section of the pipeline.

For pipelines larger than 16” in diameter, the Contractor may use the AWWA C-651 “Slug Method” for disinfecting the pipeline. Chlorine shall be fed at a constant rate and at a sufficient concentration at one end of the pipeline to develop a slug of chlorinated water having not less than 100 mg/liter of free chlorine. The Contractor shall move the slug through the main so that all interior surfaces are exposed to the slug for at least three (3) hours. The chlorine concentration in the slug shall be measured as it moves through the pipeline. If the chlorine concentration drops below 50 mg/liter, the Contractor shall stop the slug and feed additional chlorine to the head of the slug to restore the chlorine concentration to at least 100 mg/liter before proceeding. As the slug flows past fittings and valves, related valves and hydrants shall be operated so as to disinfect appurtenances and pipe branches.

Unless otherwise indicated, all quantities specified herein refer to measurements required by the testing procedures included in the current edition of “Standard Methods”. The chlorine concentration at each step in the disinfection procedure shall be verified by chlorine residual determinations.

(d) Final Flushing

The heavily chlorinated water shall then be carefully flushed from the potable water line until the chlorine concentration is no higher than the residual generally prevailing in the existing distribution system. Proper planning and appropriate preparations in handling, diluting, if necessary, and disposing of this strong chlorine solution is necessary to insure that there is no injury or damage to the public, the water system or the environment. The plans and preparations of the Contractor must be approved by the City before flushing of the line may begin. Additionally the flushing must be witnessed by an authorized representative of the City.

Approval for discharge of the diluted chlorine water or heavily chlorinated water into the wastewater system must be obtained from the Water and Wastewater Utility Department. The line flushing operations shall be regulated by the Contractor so as not to overload the wastewater system or cause damage to the odor feed systems at the lift stations. The City shall designate its own representative to oversee the work.

Daily notice of line discharging must be reported to the Water and Wastewater Utility Dispatch office.

(e) Bacteriological Testing

After final flushing of the strong disinfecting solution, two (2) sets of water samples from the line, that are taken at least twenty-four (24) hours apart, will be tested for bacteriological quality by the City and must be found free
of coliform organisms before the pipeline may be placed in service. Each set shall consist of one (1) sample that is drawn from the end of the main and additional samples that are collected at intervals of not more than 1000 feet along the pipeline. All stubs shall be tested before connections are made to existing systems.

The Contractor, at its expense, shall install sufficient sampling taps at proper locations along the pipeline. Each sampling tap shall consist of a standard corporation cock installed in the line and extended with a copper tubing goose neck assembly. After samples have been collected, the goose neck assembly may be removed and retained for future use.

Samples for bacteriological analysis will only be collected from suitable sampling taps in sterile bottles treated with sodium thiosulfate. Samples shall not be drawn from hoses or unregulated sources. The City, at its expense, will furnish the sterile sample bottles and may, at its discretion, collect the test samples with City personnel.

If the initial disinfection fails to produce acceptable sample test results, the disinfection procedure shall be repeated at the Contractor's expense. Before the piping may be placed in service, two (2) consecutive sets of acceptable test results must be obtained.

An acceptable test sample is one in which: (1) the chlorine level is similar to the level of the existing distribution system; (2) there is no free chlorine and (3) total coliform organisms are absent. An invalid sample is one, which has excessive free chlorine, silt or non-coliform growth as defined in the current issue of the "Standards Methods." If unacceptable sample results are obtained for any pipe, the Contractor may, with the concurrence of the Inspector, for one time only flush the lines and then collect a second series of test samples for testing by the City. After this flushing sequence is completed, any pipe with one or more failed samples must be disinfected again in accordance with the approved disinfection procedure followed by appropriate sampling and testing of the water.

The City of Round Rock Water Quality Laboratory will notify the assigned City of Round Rock Inspector in writing of all test results. The Inspector will subsequently notify the Contractor of all test results. The Water Quality Laboratory will not release test results directly to the Contractor.

(30) Cleanup and Restoration

It shall be the Contractor's responsibility to keep the construction site neat, clean and orderly at all times. Cleanup shall be vigorous and continuous to minimize traffic hazards or obstructions along the streets and to driveways. Trenching, backfill, pavement repair (as necessary), and cleanup shall be coordinated as directed by the City. The Engineer or designated representative will regulate the amount of open ditch and may halt additional trenching if cleanup is not adequate to allow for orderly traffic flow and access.

Materials at the site shall be stored in a neat and orderly manner so as not to
obstruct pedestrian or vehicular traffic. All damaged material shall be removed from the construction site immediately and disposed of in a proper manner. All surplus excavated materials become the property of the Contractor for disposal at his expense. After trenching, the Contractor shall immediately remove all excavated materials unsuitable for or in excess of, backfill requirements. Immediately following the pipe laying Work as it progresses, the Contractor shall backfill, grade and compact all excavations as provided elsewhere and shall immediately clean up and remove all unused soil, waste and debris and restore all surfaces and improvements to a condition equal or superior to that before construction began and to an appearance which complements the surroundings. The Contractor shall grade and dress the top 6 inches of earth surfaces with soil or other material similar and equal to the surrounding, fill and smooth any visible tracks or ruts, replace and re-establish all damaged or disturbed turf or other vegetation and otherwise make every effort to encourage the return of the entire surface and all improvements to a pleasant appearance and useful condition appropriate and complementary to the surroundings and equal or similar to that before construction began.

Permanent pavement replacement, if necessary, shall begin immediately after all testing of each segment of piping is satisfactorily completed.

510.4 Measurement
Pipe will be measured by the linear foot for the various types, sizes and classes. Parallel lines will be measured individually.

Where a line ties into an existing system, the length of the new line will be measured from the visible end of the existing system at the completed joint. Unless otherwise indicated, the length of water and wastewater lines will be measured along pipe horizontal centerline stationing through fittings, valves, manholes, and other appurtenances.

Unless otherwise provided, ductile fitting 24-inch and smaller will be measured by the ton and paid for in accordance with the schedule in Standard Product List WW-27C. Unless otherwise provided, fittings larger than 24 inch sizes will be subsidiary to the pipe. Steel cylinder concrete pipe fittings and welded steel pipe fittings will not be measured separately. These will be subsidiary to the bid item Pipe.

Stormwater pipe will be measured along the slope of the pipe. Where drainage pipe ties into inlets, headwalls, catch basins, manholes, junction boxes or other structures that length of pipe tying into the structure wall will be included for measurement but no other portion of the structure length or width will be so included.

Excavation and backfill, when included as pipe installation will not be measured as such but shall be included in the unit price bid for constructing pipe and measured as pipe complete in place including excavation and backfill.

When pay items are provided for the other components of the system, measurement will be made as addressed hereunder.
510.5 Payment

Payment for pipe, measured as prescribed above, will be made at the unit price bid per linear foot for the various sizes of pipe, of the materials and type indicated, unless unstable material is encountered or trench excavation and backfill is bid as a separate item.

The concrete seal, foundation rock or coarse aggregate when used as directed in unstable material will be paid for at the unit price bid per cubic yard, which shall be full payment for all excavation and removal of unsuitable material and furnishing, placing and compacting the foundation rock, coarse aggregate or other approved material all complete in place.

Excavation and backfill, when included as a separate pay item, will be paid for by Pay Item No. 510-E or 510-F.

(1) Pipe

Payment for pipe, measured as prescribed above, will be made at the unit price bid per linear foot complete-in-place as designed and represented in the Drawings and other Contract documents. Unless otherwise provided herein, as separate pay item(s), subsidiary items to the bid price per linear foot of pipe shall include the following:

- clearing
- constructing any necessary embankment
- excavation
- disposal of surplus or unusable excavated material
- furnishing, hauling and placing pipe
- fittings larger than 24 inch
- field constructed joints, collars, temporary plugs, caps or bulkheads
- all necessary lugs, rods or braces
- pipe coatings and protection
- connections to existing systems or structures, concrete blocking and thrust blocks and restrained joints
- preparing, shaping, pumping for dewatering, and shoring of trenches
- bedding materials
- backfill materials
- hauling, placing and preparing bedding materials
- particle migration measures
- hauling, moving, placing and compacting backfill materials
- temporary and permanent pavement repairs and maintenance
- temporary and permanent removal and replacement of pavement, curb, drainage structures, driveways, sidewalks and any other improvements damaged or removed during construction
- cleanup
- vertical stack on deep wastewater services
- all other incidentals necessary to complete the pipe installation as indicated.
No separate payment will be made for thrust restraint measures.
Steel cylinder concrete pipe fittings and welded steel pipe fittings will not be paid for separately. These will be subsidiary to the bid item Pipe.

(2) Concrete Cradles and Seals
When called for in the Bid, concrete cradles and seals will be paid for at the unit Contract price bid per linear foot for the size of pipe specified, complete in place.

(3) Concrete Retards
When called for in the Bid, Concrete retards will be paid under Item No. 593, Concrete Retards."

(4) Boring, Jacking and Tunneling
When called for in the Bid, boring, jacking and tunneling will be paid under Item 501, "Jacking or Boring Pipe" or Item 502, "Tunneling".

(5) Wet Connections to Water Mains
When called for in the bid, wet connections will be paid at the unit price bid per each, complete in place, according to the size of the main that is in service and shall be full compensation for all Work required to make the connection and place the pipe in service. (See subsection 510.3 ‘Construction Methods part (24) (b) ‘Wet Connections to Existing Water System’).

(6) Fittings
Cast iron and ductile iron fittings of the class indicated, furnished in accordance with these specifications will be paid for at the unit price bid per ton, complete in place, according to scheduled weights for mechanical joint fittings furnished, including glands, bolts and gaskets, as published in the following standards:

AWWA C-153 for all fittings 4-inch through-24 inch sizes, regardless of whether AWWA C-110 or

AWWA C-153 fittings are furnished or the type of end connections supplied.

AWWA C-110 for all fittings larger than 24-inch size.

Steel cylinder concrete pipe fittings and welded steel pipe fittings will not be paid for separately. The Contractor shall include these in his bid for pipe.

(7) Concrete Trench Cap and Encasement
Where the distance between the top of the concrete encasement and the top of the trench cap is less than 36 inches, the concrete cap and encasement shall be poured as one unit and paid for under this bid item at the Contract price bid per linear foot. When the distance above is greater than 36 inches or when the trench cap is placed separately, the trench cap shall be paid for as a separate item, per linear foot, complete in place.
(8) Cement-Stabilized Backfill
Cement-stabilized backfill will be paid for at the unit price bid per linear foot and shall be full payment to the Contractor for furnishing and installing the required material, mixed, placed and cured complete in place.

(9) Concrete Encasement
When called for in the Bid, Concrete Pipe Encasement will be paid under Item No. 505, "Encasement and Encasement Pipe".

(10) Pressure Taps
Pressure taps will be paid for at the unit price bid, complete in place, according to the size tap made and the size main tapped and shall be full payment for furnishing all necessary materials, including tapping sleeve and valve, making the tap, testing and placing the connection in service.

(11) Trench Safety Systems
When called for in Bid, Trench Safety Systems shall conform to Item No. 509, "Trench Safety Systems".

(12) In-Place Slip Lining with or without In-Place Pipe Destruction/Replacement
As called for in the corresponding bid items, pipe slip lining with or without in-place pipe destruction/replacement will be paid for at the Contract price per linear foot for the specified liner and pipe size and type pipe, at all depths, complete in place.

Installation of new services, or reconnection of existing services, to the liner will be paid for at the Contract price per each for the specified size and type of service, at all depths, complete in place.

(13) Cured Resin Pipe Lining
When called for in the bid, cured resin pipe lining will be paid for per linear foot, for the size and type of pipe lined, at all depths, complete in place including all equipment set-ups, video inspection and cleaning of existing pipe. Installation of new services or reconnection of existing services to the relined pipe will be paid for per each, for the specified size and type of service, at all depths, complete in place.

Payment, when included as a Contract pay item, will be made under one of the following:

Pipe, __Dia. ____ (all depths), including Excavation and Backfill Per Linear Foot.
In-Place Slip Lining without In-Place Pipe Destruction/Replacement
(____Dia. _____ Pipe Lining ____ in. Dia. Existing Pipe) Per Linear Foot.
In-Place Slip Lining with Pipe Destruction/Replacement
(____ Dia. ___ Replacement Pipe ____ in. Dia. Existing Pipe) Per Linear Foot.
Installing or Reconnecting Lateral Service to Existing, Relined or Replaced Pipe (____Dia. _____Service) in. (____ Dia. _____Pipe) Per Each.
Pipe Excavation, _____Ft. Width Per Linear Foot.
Pipe Trench Backfill, _____Ft. Width Per Linear Foot.
Concrete Seal or Cradle, _____Dia. Pipe Per Linear Foot.
Concrete Trench Cap, _____Ft. Width Per Linear Foot.
Concrete Cap and Encasement, _____Dia. Pipe Per Linear Foot.
Cement Stabilized Backfill, _____Dia. Pipe Per Linear Foot.
Cured Resin Pipe Lining (for _____Dia. Pipe) Per Linear Foot.
Installing or Reconnecting Lateral Service to Cured Resin Lined Pipe, (_____Dia. _____Service (for _____Dia. Main) Per Each.
Pressure Taps, ____ Dia. X ____ Dia. Per Each.
Wet Connections, ____ Dia. X ____ Dia. Per Each.
Ductile Iron Fittings 4 inch through 24 inch Per Ton.

A "W" after the pay item indicates the use for water.
A "WW" after the pay item indicates the use for wastewater.

End

Applicable References:


ITEM NO. 551
PIPE UNDERDRAINS

551.1 Description
This item shall consist of pipe underdrains embedded in filter material, constructed at such places as indicated and in accordance with lines and grades established by Engineer. This item shall also consist of any pumping, bailing, drainage and Item No. 509, "Trench Safety Systems" for trench walls, when indicated.

551.2 Materials
(1) Pipe
The following materials will be permitted as alternates unless type is indicated. Size indicated shall be inside diameter. Pipe shall meet the following requirements:

Type 1 Vitrified Clay or Concrete Pipe
Pipe may be either thoroughly and perfectly burned or glazed vitrified clay or nonreinforced concrete conforming to ASTM C 14. Vitrified clay pipe shall be of first quality hub and spigot style, sound, without warps or cracks or other imperfections and shall be sufficiently tough so that it may be cut with a chisel and hammer.

Type 2 Clay Drain Tile
Standard clay drain tile shall conform to specifications of AASHTO M 179.

Type 3 Concrete Drain Tile
Butt end concrete drain tile shall conform to ASTM C 412. Tongue and groove concrete drain tile shall conform to ASTM C 118.

Type 4 Porous Concrete Pipe
Porous concrete pipe shall conform to AASHTO M 176.

Type 5 Perforated Clay Pipe
Perforated clay pipe shall conform to specifications for standard strength perforated clay pipe of AASHTO M 65 except that extra strength clay pipe may be substituted for standard strength clay pipe.

Type 6 Perforated Corrugated Metal Pipe
Perforated helically corrugated metal pipe shall be fabricated from corrugated galvanized sheets and shall conform to AASHTO M 36 or corrugated aluminum alloy sheets and shall comply with AASHTO M 196.

Type 7 Perforated Corrugated Metal Pipe (Bituminous Coated)
Pipe shall conform in all particulars to requirements specified above for perforated corrugated metal pipe. Steel pipe shall be uniformly coated inside and out with a bituminous coating to a minimum thickness of 0.05 inch.
Bituminous material used to coat pipe shall meet the following requirements when tested in accordance with TxDOT Test Method Tex-522-C:

<table>
<thead>
<tr>
<th>Solubility, % by wt. in</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trichloroethylene</td>
</tr>
<tr>
<td>Brittleness Test</td>
</tr>
<tr>
<td>Flow, inches</td>
</tr>
</tbody>
</table>

Type 8 Perforated Concrete Pipe
Perforated concrete pipe shall conform to ASTM C 444, “Standard Strength Perforated Nonreinforced Concrete Underdrain Pipe”, except that “Extra Strength Perforated Nonreinforced Concrete Underdrain Pipe” may be substituted for standard strength pipe.

Type 9 ABS Perforated Pipe
ABS pipe shall be extruded and fittings molded from virgin ABS plastic material conforming to ASTM D 1788, Type 4, except that minimum heat deflection temperature is 180°F. Contractor shall furnish certified test reports as evidence that material used for project meets ASTM requirements. Dimensions of ABS pipe shall be as shown in Table I. Fittings shall conform to manufacturer's standard for particular size of pipe required.

<table>
<thead>
<tr>
<th>TABLE I</th>
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<tbody>
<tr>
<td>Nominal Size, Inches</td>
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<tr>
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<tr>
<td>4</td>
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<tr>
<td>6</td>
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</table>

Perforations shall conform to requirements for Type 5 pipe underdrains. Crushing strength of ASB pipe shall meet or exceed minimum values in Table II when tested in accordance with flat-plate loading method as outlined in ASTM Designation: D 2412.

<table>
<thead>
<tr>
<th>TABLE II</th>
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</thead>
<tbody>
<tr>
<td>Nominal Size, Inch</td>
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<tr>
<td>4</td>
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<td>6</td>
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</tbody>
</table>

Pipe shall withstand at least 35 percent vertical deflection without rupture of pipe wall and stiffness shall equal or exceed valves at 5 percent deflection. Vertical deflection shall be computed as follows:

Percent Deflection = \( \frac{\text{Reduction Vert. I.D.}}{\text{Nominal I.D.}} \times 100 \)
Ends of ABS pipe, couplings and fittings shall be perpendicular or square to longitudinal axis of main body within a maximum angle of 3 degrees. Outer and inner surface of pipe shall be free from blisters, voids and discontinuities.

Type 10 Preformed Corrugated Polyethylene Plastic Tubing
Tubing shall comply with AASHTO M 252.

Type 11 Perforated Polyvinyl Chloride Pipe
Pipe shall be Schedule 40 and conform to ASTM D 1785. Unless otherwise specified, the perforated pipe shall have two rows of holes 13 mm (½ in.) in diameter on 125-mm (5 in.) centers, with allowable tolerances of ±1 mm (1/16 in.) on the diameter and + 6, -0 mm (+¼, -0 in.) on the spacing, and the rows shall be parallel to the axis of the pipe and 120 ±5° apart.

(2) Filter Material
   (a) Aggregate
       Filter material for use in backfilling trenches under, around and over underdrains shall consist of hard, durable, clean, washed gravel or crushed stone, ranging in size from 5/8 to 1 inch and shall be free from organic matter, clay balls or other deleterious matter.
   (b) Geotextile
       Geotextile shall conform to Item No. 620, "Filter Fabric".

551.3 Construction Methods
Excavation of each trench shall begin at its outlet and proceed toward its upper end. Trench must not be excavated below proposed grade line and shall be located as indicated or as directed by Engineer and true to line and grade. Trench shall be dressed with a tile hoe or shovel in such manner that will facilitate placement of underdrain. Closed joints shall be coupled with bands, solvent weld couplings or integral joints. Perforated ABS pipe shall be jointed by couplers or solvent welding according to manufacturer's recommendation. No tar paper strips shall be used.

Approved plugs shall be placed in upper ends of pipes and exposed ends of underdrains shall be covered with ½ inch galvanized hardware cloth and filter fabric.

When indicated, concrete riprap or headwalls of dimensions indicated shall be constructed at outlet ends of pipe underdrains. Concrete materials and proportions shall conform to requirements specified for Class B Concrete conforming to Item No. 403, "Concrete for Structures".

When perforated metal pipe is used and trench is founded in pervious material, a thin layer of tamped impervious material shall be placed on bottom of trench as indicated or as directed by Engineer. Sections shall be jointed with band couplers.

When clay or concrete pipe is used and trench is founded in pervious material, a bottom course of specified filter material shall be placed and tamped to a uniform depth of 2 inches. Pipe shall then be firmly embedded in filter material, hub upgrade and spigot firmly centered into adjacent hub end or in the case of butt end type drains with an open
joint of approximately 3/8 inch. Open joints shall then be covered with approved 2 ply tar
crude strips not less than 6 inches in width and of sufficient length to permit ends being
turned outward and laid flat on bottom course of filter material of each side for a
distance of 3 inches. When trench is founded in impervious material, the 2 inch bottom
course of filter material shall be omitted, pipe laid directly in trench and filter material
placed in trench to a depth of 2 inches on each side of pipe. Two ply tar paper strips
shall then be placed as specified above.

551.4 Measurement
Work and accepted materials for "Pipe Underdrains" shall be measured by the linear foot
of pipe measured along slope and shall include clearing, excavation, filter material, filter
fabric, pipe, length of elbows, wyes, tees and other branches and backfill.

551.5 Payment
Work performed and materials furnished as prescribed by this item and measured as
provided under "Measurement" will be paid for at the unit price bid per linear foot of
"Pipe Underdrains" of type and size specified, which price shall be full compensation for
furnishing and placing materials, for underdrain excavation and backfill, for filter
materials, for plugs and screens and for labor, tools, equipment and incidentals
necessary to complete the work.

Any riprap, headwalls or Trench Safety System indicated will be measured and paid for in accordance with provisions of Item No. 403, "Concrete for Structures", Item No. 410,
"Concrete Structures", Item No. 509, "Trench Safety Systems" and Item No. 591,
"Riprap for Slope Protection".

Payment will be made under:

Pipe Underdrains, In. - Per Linear Foot.

End
Ref: 403, 410, 509, 591, 620
ITEM NO. 602
SODDING FOR EROSION CONTROL

602.1 Description
This item shall govern planting of Bermuda grass; St. Augustine or other acceptable grass sod at locations indicated on the Drawings or as directed by the Engineer or designated representative in accordance with this Standard Specification Item.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text and accompanying tables, the inch-pound units are given preference followed by SI units shown within parentheses.

602.2 Submittals
The submittal requirements for this specification item shall include the identification of the type and source of sodding, the type of mulch, type of tacking agent and type and rate of application of fertilizer.

602.3 Materials
A. Block and Mulch Sod
The sod shall consist of live, growing Bermuda Grass, St. Augustine grass, when shown on the Drawings, or other acceptable grass sod indicated on the Drawings secured from sources that are approved by the Engineer or designated representative. Bermuda Grass sod, St. Augustine sod or other grass sod as shown on the Drawings shall have a healthy, virile root system of dense, thickly matted roots throughout the soil of the sod for a minimum thickness of 1 inch (25 millimeters). The thickness measure does not include grass. The sod shall be cut in rectangular pieces with its shortest side not less than 12 inches (300 mm). The Contractor shall not use sod from areas where the grass is thinned out nor where the grass roots have been dried out by exposure to the air and sun to such an extent as to damage its ability to grow when transplanted.

The sod shall be substantially free from noxious weeds, Johnson grass or other grasses and shall not contain any matter deleterious to its growth or which might affect its subsistence or hardiness when transplanted. Unless the area has been closely pastured, it shall be closely mowed and raked to remove all weeds and long standing stems. Sources from which sod is to be secured shall be approved by the Engineer or designated representative.

Care shall be taken at all times to retain the native soil of the roots of the sod during the process of excavating, hauling and planting. Sod material shall be kept moist from the time it is dug until it is planted. The sod existing at the source shall be watered to the extent required by the Engineer or designated representative prior to excavating.
B. Fertilizer
Fertilizer and the rate of application shall conform to the requirements of Standard Specification Item No. 606, "Fertilizer".

C. Mulch
Straw mulch shall be oat, wheat or rice straw. Hay mulch may be substituted for straw mulch and shall be Prairie Grass, Bermuda grass or other hay approved by the Engineer or designated representative. The hay or straw mulch shall be free of Johnson grass or other noxious weeds and foreign materials. It shall be kept in a dry condition and shall not be molded or rotted.

D. Water
Water shall be furnished by the Contractor and shall be clean and free of industrial wastes and other substances harmful to the growth of sod or to the area irrigated.

E. Tacking Agents
Tacking agents for straw or hay mulch shall be as shown on the Drawings.

602.4 Planting Season
All planting shall be done between April and November except as specifically authorized in writing by the Engineer or designated representative.

602.5 Construction Methods
A. General
After the designated areas have been completed to the lines, grade and cross sections indicated on the Drawings, the surface shall be worked to a depth of not less than 4 inches (100 mm) with a disc, tiller or other equipment approved by the Engineer or designated representative. Fertilizer nutrients shall be applied and tilled. Areas that become crusted shall be reworked to an acceptable condition before sodding. Sodding of the type specified shall conform to the requirements of this Specification Item. The Contractor shall give continuous care to the sodded area until the sod is accepted.

B. Placement
The sod shall be placed on the prepared surface with the edges in close contact and alternate courses staggered. In ditches the sod shall be placed with the longer dimension perpendicular to the flow of water in the ditch. On slopes, starting at the bottom of the slope, the sod shall be placed with the longer dimension parallel to the contours of the ground. The exposed edges of sod shall be buried flush with the adjacent soil. On slopes exceeding 3:1 or where the sod may be displaced, the sod shall be pegged with not less than 4 stakes or ground staples per square yard (square meter) with at least 1 stake or ground staple for each piece of sod.

Pegs shall be of wood lath or similar material, pointed and driven with the flat side against the slope, 6 inches (150 mm) into the ground, leaving approximately...
1/2 inch (12.5 mm) of the top above the ground. Ground staples shall not be less than 13 inches (330 mm) in length and shall be constructed of No. 11 gage (3 mm) wire that is bent to form a "U" approximately 1 inch (25 mm) in width.

C. Watering

Immediately after the area is sodded, it shall be watered with a minimum of 5 gallons of water per square yard (22.5 liters per square meter) and at 10 day intervals as needed and as directed by the Engineer or designated representative. Subsequent to the initial application, water shall be applied at a minimum rate of 3 gallons per square yard (13.5 liters per square meter), as required on the Drawings or as directed by the Engineer or designated representative until final acceptance by the City or until the grass uniformly reaches a height of 2 1/2 inches (62.5 mm).

Watering shall comply with City Ordinances.

D. Finishing

Where applicable, the shoulders, slopes and ditches shall be smoothed after planting has been completed and shaped to conform to the desired cross sections shown on the Drawings. Any excess soil from planting operations shall be spread uniformly over adjacent areas or disposed of as directed by the Engineer or designated representative so that the completed surfaces will present a neat appearance. All sodded areas shall be rolled after the initial watering application, when sufficiently dry.

602.6 Block Sodding

At locations indicated on the Drawings or where directed by the Engineer or designated representative, sod blocks shall be carefully placed on the prepared areas. The fertilizer shall then be applied in accordance with the applicable provisions of Item No. 606, "Fertilizer" and thoroughly watered. When sufficiently dry, the sodded area shall be rolled or tamped to form a thoroughly compacted, solid mat. Any voids left in the block sodding shall be filled with additional sod and tamped. Surfaces of block sod which, in the opinion of the Engineer or designated representative may slide due to the height and slope of the surface or nature of the soil, shall be pegged with wooden pegs driven through the sod blocks into firm earth sufficiently close to hold the block sod firmly in place. Edges along curbs and drives, walkways, etc., shall be carefully trimmed and maintained until the sodding is accepted.

602.7 Mulch Sodding

The sod source shall be disked in 2 directions cutting the sod thoroughly to a depth of not less than 4 inches (100 mm). Sod material shall be excavated to a depth of not more than 2 inches (50 mm) below the existing root system, being careful to avoid having soil containing no grass roots. The disked sod may be windrowed or otherwise handled in a manner satisfactory to the Engineer or designated representative. The material shall be rejected if not kept in a moist condition.

Prior to placement of mulch sod, the cut slopes shall be scarified by plowing furrows 4 inches (100 mm) to 6 inches (150 mm) deep along horizontal slope lines at 2 foot (600
mm) intervals. Excavated material from the furrows shall not protrude more than 3 inches (75 mm) above the original surface of the cut. Fertilizer shall be distributed uniformly over the area in accordance with the applicable provisions of Item No. 606, "Fertilizer". The sod shall then be deposited upon the prepared area and spread uniformly to the thickness indicated on the Drawings.

Any section that is not true to lines and cross sections shall be remedied by the addition of sod material or by reshaping the material to meet the requirements of "Finishing" [Section 602.5 (4)]. After the sod material has been spread and shaped, it shall be thoroughly wetted and compacted with a corrugated roller of the "Cultipacker" type. All rolling of slope areas shall be on the contour.

602.8 Measurement
Work and acceptable material for "Sodding for Erosion Control" will be measured by the square yard (square meter: 1 square meter is equal to 1.196 square yards) complete in place with a minimum of 95 percent growth with a 2 1/2 inch (62.5 mm) stand of grass.

602.9 Payment
The work performed and materials furnished and measured as provided under "Measurement" will be paid for at the unit bid price for Bermuda Block Sodding", "St. Augustine Block Sodding", "Bermuda Mulch Sodding" or "Other Approved Grass Sodding". The prices shall each represent full compensation for completion of the work including all water applications, rolling, pegging and fertilizer as indicated on the Drawings.

Payment will be made under one of the following:

- Bermuda Block Sodding – Per Square Yard.
- St. Augustine Block Sodding – Per Square Yard.
- Bermuda Mulch Sodding – Per Square Yard.
- Grass Sodding – Per Square Yard.

End
### SPECIFIC CROSS REFERENCE MATERIALS

<table>
<thead>
<tr>
<th>Designation</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>Item No. 606</td>
<td>Fertilizer</td>
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### RELATED CROSS REFERENCE MATERIALS

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<th>Designation</th>
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<td>Street Excavation</td>
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<td>Item No. 111</td>
<td>Excavation</td>
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<tr>
<td>Item No. 120</td>
<td>Channel Excavation</td>
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<td>Item No. 132</td>
<td>Embankment</td>
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<td>Item No. 601</td>
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<td>Item No. 604</td>
<td>Seeding for Erosion Control</td>
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<td>Item No. 608</td>
<td>Planting</td>
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<tr>
<td>Item No. 610</td>
<td>Preservation of Trees and Other Vegetation</td>
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Texas Department of Transportation: *Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges*

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<td>Furnishing and Placing Topsoil</td>
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<td>Item No. 166</td>
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<td>Item No. 204</td>
<td>Sprinkling</td>
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ITEM NO. 610
PRESERVATION OF TREES AND OTHER VEGETATION

610.1 Description
This item shall govern the proper care and treatment of all trees and other vegetation in the vicinity of any development activity.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text and accompanying tables, the inch-pound units are given preference followed by SI units shown within parentheses.

610.2 Submittals
The submittal requirements for this specification item shall include:

A. Identification of the location, type of protective fencing (i.e. A, B or C), materials of construction and installation details;
B. Proposed tree dressing;
C. Type, location and construction details for proposed tree wells;
D. Location, type, materials of construction and installation details for permeable paving;
E. Type and rate of application of fertilizer;

610.3 Materials
A. Protective Fencing

Protective fencing is designated as the materials used to protect the root zones of trees. Three basic types of protective fencing materials are allowed. Type A and Type B are typical applications and shall be installed where damage potential to a tree root system is high, while Type C shall be installed where damage potential is minimal. The specific type of protective fencing for the work shall be as indicated on the Drawings. Type C fence materials shall be subject to approval by the City Forestry Manager for Site Permit Projects, or the Engineer or designated representative for City of Round Rock administered projects. Type C fencing shall be replaced by Type A or Type B fencing as directed by the Engineer or designated representative if it fails to perform the necessary function.

1. Type A Chain Link fence (Typical Application-high potential damage)

Type A protective fencing shall be installed in accordance with the Drawings and shall consist of a minimum five-foot (1.5 meters) high chain link fencing with tubular steel support poles or "T" posts.
2. Type B Wood Fence (Typical Application-high potential damage)

Type B protective fencing shall be installed in accordance with the Drawings and shall consist of any vertical planking attached to 2x4-inch (50 x 100 mm) horizontal stringers which are supported by 2x4-inch (50 x 100 mm) intermediate vertical supports and a 4x4-inch (100 x 100 mm) at every fourth vertical support.

3. Type C Other Materials (Limited Application-minimal potential damage)

The following materials may be permitted as alternates for limited or temporary applications (3 days or less) where tree damage potential is minimal (as determined by the City Forestry Manager or designated representative for Site Permit Projects, or the Engineer or designated representative on City of Round Rock administered projects):

   (a) High visibility plastic construction fencing.

   The fabric shall be 4 feet (1.2 meters) in width and made of high density polyethylene resin, extruded and stretched to provide a highly visible international orange, non-fading fence. The fabric shall remain flexible from -60°F to 200°F (-16°C to 93°C) and shall be inert to most chemicals and acid. The fabric pattern may vary from diamond to circular with a minimum unit weight of 0.4 lbs./Ft. (0.6 kilograms per meter).

   The fabric shall have a 4 foot (1.2 meters) width minimum tensile yield strength (Horizontal) of 2000 psi [13.9 megaPascals], ultimate tensile strength of 2680 psi [18.5 megaPascals] (Horizontal) and a maximum opening no greater than 2 inches (50 mm).

   (b) Fencing Supports.

   The fencing materials, identified in (a) and (b) above, shall be supported by steel pipe, tee posts, U posts or 2" x 4" (50 mm x 100 mm) timber posts that are a minimum of 5-1/2 feet (1.68 meters) in height and spaced no more than 8 feet (2.44 meters) on centers. The fabric shall be secured to posts by bands, wire ties, or other suitable methods subject to the approval of the Engineer or designated representative.
B. Trunk Protection (Limited Application)

When indicated on the Drawings or directed by the City Forestry Manager or designated representative for Site Permit Projects or the Engineer or designated representative for City of Round Rock administered projects, tree trunk protection shall be provided. Tree trunk protection shall consist of any 2 x 4-inch (50 x 100 mm) or 2 x 6-inch (50 x 150 mm) planking or plastic strapping.

C. Tree Dressing

Tree dressing of any damaged areas shall be accomplished using any approved asphaltic tree wound paint, immediately after damage occurs.

D. Tree Wells for Raised Grades

When existing grades are raised by more than 6 inches (150 mm), the tree root system shall be protected by the installation of tree wells as approved by the City Forestry Manager. Native stone, railroad ties or equivalent timber shall be used for the separator wall of the well and PVC conforming to ASTM D-2729, SDR-35 shall be used for the aeration systems in fill areas.

E. Permeable Paving.

Permeable segmented pavers in conjunction with PVC pipe aeration system or concrete on gravel base with cored holes shall be used to protect existing tree root zones when indicated on the Drawings as approved by the City Forestry Manager or designated representative for Site Permit Projects or the Engineer or designated representative for City of Round Rock administered projects.

F. Fertilizer

Fertilizer shall conform to City of Round Rock Standard Specification Item No. 606, "Fertilizer".

610.4 Construction Methods

A. Protective Fencing

All trees and shrubs in the proximity of the construction site shall be carefully checked for damage prior to initiation of any development activity.

All individual trees, shrubs, and natural areas scheduled for preservation shall be protected during construction with temporary fencing as indicated on the Drawings or directed by the City Forestry Manager or designated representative for Site Permit Projects or the Engineer or designated representative for City of Round Rock administered projects.
Protective fences (section 610.3.A) shall be installed prior to the start of any site preparation work (clearing, grubbing, or grading), and shall be maintained in functioning condition throughout all phases of the construction project.

Protective fence locations in close proximity to intersecting streets or drives shall adhere to the sight distance and sight triangle required by the City.

1. Protective fences shall be constructed at the locations (typically the outer limits of the Critical Root Zone) and with materials indicated on the Drawings to prevent the following:

   (a) Soil compaction in the root zone area resulting from vehicular traffic or storage of equipment or materials.

   (b) Root zone disturbances due to grade changes [greater than 6" (150 mm) cut or fill] or trenching not reviewed and authorized by the City Forestry Manager or designated representative or the Engineer or designated representative.

   (c) Damage to exposed roots, trunks or limbs by mechanical equipment.

   (d) Other activities detrimental to trees such as chemical storage, concrete truck cleaning, and fires.

2. Exceptions to the installation of protective fences at the tree drip lines may be permitted in the following cases:

   (a) Where there is to be an approved grade change, impermeable paving surface, tree well, or other such site development, the fence shall be erected approximately 2 to 4 feet (0.6 to 1.2 meters) beyond the area of disturbance;

   (b) When permeable paving is to be installed within a tree drip line, the fence shall be erected at the outer limits of the permeable paving area (prior to any site grading so that this enclosed area is graded separately to minimize root damage);

   (c) When trees are located close to a proposed building or other construction activity, the fence shall be erected to allow 6 to 10 feet (1.8 to 3 meters) of work space between the fence and the structure and apply organic mulch to a depth of four (4) to six (6) inches [100 to 150 mm] in the unprotected root zone area;

   (d) When there are street-side pedestrian walkways, fences shall be constructed in a manner that does not obstruct safe passage;
(e) When there are severe space constraints due to tract size or other special requirements, the Contractor shall contact the City Forestry Manager on Site Permit projects or the Engineer or designated representative for City administered projects to discuss alternatives.

When any of the exceptions listed above will result in a fence being located closer than five (5) feet (1.5 meters) to a tree trunk, the Contractor shall also protect the trunk with strapped-on planking to a height of 8 feet [2.4 meters] (or to the limits of lower branching) in addition to the reduced fencing required.

B. Repair of Damage

Tree roots scarred by equipment shall be cut cleanly and covered with topsoil. When tree roots are pruned, a comparable portion of selected branches shall be cut from the tree on the opposite side. Limb pruning shall be made at the branch collar as indicated on the Drawings. All limbs greater than 1 inch (25 mm) in diameter shall be precut in accordance with ANSI 300 pruning methods to prevent splitting. All cut limbs shall be treated with an approved tree dressing. Tools shall be disinfected with alcohol or 5 ppm chlorine solution between repairs to trees to prevent the transmission of diseases from one tree to another.

All trees damaged during construction shall receive an application of fertilizer within the drip line conforming to Standard Specification Item No. 606, "Fertilizer" at the rate of 4 pounds per caliper inch (.07 kilograms per caliper mm).

C. Cutting and Filling Around Trees

When the depth of an excavation or embankment exceeds 6 inches (150 mm) within the drip line of any tree with a diameter greater than 8 inches (200 mm), a tree well shall be constructed to protect the tree as indicated on the Drawings.

D. Paving Around Trees

Where paving within the dripline of any tree greater than a 6 inch (150 mm) diameter is necessary, a permeable pavement and aeration system must be installed as indicated on the Drawings, except for street construction.

E. Tree Removal

When a tree or shrub is scheduled for removal, it shall be cut to a depth of 12 inches (300 mm) below the surrounding ground line. After removal, soil shall be placed in the hole to a depth matching the existing grade. The tree shall be cut into sections that can be managed, removed from the site and disposed of. All work shall be conducted in such a manner as to protect all facilities, improvements and vegetation in the work area.
Removal of any other trees not scheduled for removal shall be subject to the provisions of the City Tree Ordinance.

All damage resulting from tree removal or pruning shall be repaired at the Contractor's own expense.

F. Final Cleanup

All temporary tree and shrub preservation and protection measures shall be removed when the construction has been completed.

610.5 Measurement

Tree and shrub trimming, fencing, drains, fertilization, etc. will not be measured for payment unless included as a contract pay item. Tree wells for tree protection will be measured by the units, complete in place, conforming to the Drawings.

610.6 Payment

The work and materials prescribed herein with the exception of the Tree Wells will not be paid for directly but shall be considered subsidiary to other items unless a payment item is included as a contract pay item.

If included as a pay item, payment will be made under one of the following:

- Protective Fencing Type A Chain Link fence
  
  (Typical Application-high damage potential) Per Lineal Foot

- Protective Fencing Type B Wood Fence
  
  (Typical Application-high damage potential) Per Lineal Foot

- Protective Fencing Type C Other Materials
  
  Limited Application-minimal damage potential) Per Lineal Foot

- Tree Well (Tree Protection) Per Each.

End

SPECIFIC CROSS REFERENCE MATERIALS

| Specification Item 610 "PRESERVATION OF TREES AND OTHER VEGETATION" |
| City of Round Rock Standard Specification Items |
| Designation | Description |
| Item No. 606 | Fertilizer |

ASTM, American Society for Testing and Materials

| Designation | Description |
| D-2729 | Specification for Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings |
## RELATED CROSS REFERENCE MATERIALS

**Specification 610, “PRESERVATION OF TREES AND OTHER VEGETATION”**

City of Round Rock Standard Specification Items

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Texas Department of Transportation: **Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges**

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642 Silt Fence

ITEM NO. 642
SILT FENCE

642.1 Description
This item shall govern the provision and placement of a filter fabric fence including maintenance of the fence, removal of accumulated silt and removal of the silt fence upon completion of the project.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

642.2 Submittals
The submittal requirements for this specification item shall include:

A. Source, manufacturer, characteristics and test data for the filter fabric,
B. Manufacturer, characteristics and test data for the posts and wire fence.

642.3 Materials
A. Fabric
   1. General:
      The filter fabric shall be of nonwoven polypropylene, polyethylene or polyamide thermoplastic fibers with non-raveling edges. The fabric shall be non-biodegradable, inert to most soil chemicals, ultraviolet resistant, unaffected by moisture or other weather conditions, and permeable to water while retaining sediment. The filter fabric shall be supplied in rolls a minimum of 36 inches (0.9 meter) wide.
   2. Physical Requirements:
      The fabric shall meet the requirements presented in Table 1, when sampled and tested in accordance with the methods indicated herein, and/or on the Drawings.

B. Posts:
   Posts shall be painted or galvanized steel Tee or Y-posts with anchor plates, not less than 5 feet (1.5 meters) in length with a minimum weight of 1.3 pounds per foot (1.9 kilograms per meter) with a minimum Brinell Hardness of 143. Hangers shall be adequate to secure fence and fabric to posts. Posts and anchor plates shall conform to ASTM A-702.

C. Wire Fence:
   Wire fence shall be welded wire fabric 2 x 4 - W1.0 x W1.0 (50 x 100 - MW7 x MW7) and shall conform to Standard Specification Item No. 406, "Reinforcing Steel".
TABLE 1. Filter Fabric Requirements

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<td>Water Flow Rate in gallons/sq. foot/minute (liters/square meter/minute)</td>
<td>TEX-616-J(^1)</td>
<td>40 maximum (1630 maximum)</td>
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<td>Equivalent Sieve Opening Size: US Standard (SI Standard sieve size)</td>
<td>CW-02215(^2)</td>
<td>40 to 100 (425 to 150 mm)</td>
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<td>Mullen Burst Strength: lbs. per sq. inch (psi) megaPascal (mPa)</td>
<td>ASTM D-3786(^3)</td>
<td>300 minimum (2 minimum)</td>
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<td>Ultraviolet Resistance; % Strength Retention</td>
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1 TxDOT Test Method Tex-616-J, "Testing of Construction Fabrics".
4 ASTM D-1682, "Test Methods for Breaking Load and Elongation of Textile Fabrics".

642.4 Construction Methods

The silt fence fabric shall be securely attached to the posts and the wire support fence with the bottom 12 inches (300 mm) of the filter material buried in a trench a minimum of 6 inches (150 mm) deep and 6 inches (150 mm) wide to prevent sediment from passing under the fence. When the silt fence is constructed on impervious material, a 12-inch (300-mm) flap of fabric shall be extended upstream from the bottom of the silt fence and weighted to limit particulate loss. No horizontal joints will be allowed in the filter fabric. Vertical joints shall be overlapped a minimum of 12 inches (300 mm) with the ends sewn or otherwise securely tied.

The silt fence shall be a minimum of 24 inches (0.6 meter) high. Posts shall be embedded a minimum of 12 inches (300 mm) in the ground, placed a maximum of 8 feet (2.4 meters) apart and set on a slight angle toward the anticipated runoff source. When directed by the Engineer or designated representative, posts shall be set at specified intervals to support concentrated loads.

The silt fence shall be repaired, replaced, and/or relocated when necessary or as directed by the Engineer or designated representative. Accumulated silt shall be...
removed when it reaches a depth of 6 inches (150 mm), or lesser depth if the integrity of the silt fence has been jeopardized.

642.5 Measurement
The work performed and the materials furnished under this item will be measured by the lineal foot of "Silt Fence", complete in place.

642.6 Payment
The work performed and materials furnished and measured as provided under "Measurement" will be paid for at the unit bid price per lineal foot of "Silt Fence". The price shall include full compensation for furnishing, hauling and placing all materials, labor, tools, equipment and incidentals necessary to complete the work including inspecting, repairing, replacing and relocating the fence, removal of silt and removal and disposal of all materials at the completion of construction and re-vegetation of disturbed areas.

Payment will be made under:

- Silt Fence for Erosion Control Per Lineal Foot.

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Texas Department of Transportation Manual of Testing Procedures

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U.S. Army Corps of Engineers

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Specification 642 “SILT FENCE”

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ITEM NO. 700
MOBILIZATION

700.1 Description
This item shall govern the mobilization of personnel, equipment and materials at the work site for other contract items that will be performed by the Contractor. Mobilization shall include, but not be limited to the movement of equipment, personnel, material, supplies, etc. to the Work site; the installation of temporary facilities (when not paid for separately) and the establishment of office and other necessary facilities prior to the initiation of the Work. The cost of the Payment Bond and Performance Bond on the Work that is delayed due to circumstances beyond Contractor’s control, a closed construction season or for the convenience of the Owner/Developer will be considered part of the mobilization item under this Contract.

700.2 Measurement
Measurement of the Specification Item, “Mobilization”, as specified herein as "Total Mobilization Payment", will be by the “Lump Sum”, as the Work progresses.

700.3 Payment.
The adjusted contract amount as used below is defined as the original contract amount less the lump sum bid for Mobilization and any payments for materials or equipment not yet incorporated in the Work. The Contractor shall submit a lump sum amount for Payment Item "Total Mobilization Payment".

"Initial Mobilization Payout" as used below is defined as:
1. 8% of the original contract amount for projects with an original contract amount of $0.5 million or less; or
2. 4% of the original contract amount for projects with an original contract amount greater than $0.5 million.

In those instances where the "Initial Mobilization Payout", as defined above, exceeds the "Total Mobilization Payment" lump sum bid item “Total Mobilization Payment” shall be used as the "Initial Mobilization Payout". In no instance shall the "Initial Mobilization Payout" exceed the "Total Mobilization Payment" bid item.

Partial payments of the "Initial Mobilization Payout" shall be as follows:
A. Upon presentation of a paid invoice for the Payment Bond, Performance Bond and/or required insurance, the Contractor will be paid that cost from the amount bid for "Total Mobilization Payment".
B. The Mobilization of tunnel boring machines, batch plants or other similar facilities, along with supporting materials and equipment, to the work site or to the vicinity of the Work site will be considered as partial Mobilization under this contract. The Contractor shall provide a certified statement of his expenditure for the Mobilization and setup of the facility and supporting equipment. Upon approval by the Engineer or designated representative, the certified expenditure will be paid from the amount bid for the Specification Item, “Total Mobilization
Payment”. In no case shall the combined amount for all of these facilities be more than 10 percent of the “Total Mobilization Payment” lump sum bid or one (1) percent of the total contract amount, whichever is less.

C. When one (1) percent of the adjusted contract amount is earned, 50 percent of the "Initial Mobilization Payout" will be paid. Previous payments under this item will be deducted from this amount.

D. When five (5) percent of the adjusted contract amount is earned, seventy-five (75) of the "Initial Mobilization Payout" will be paid. Previous payments under this item will be deducted from this amount.

E. When ten (10) percent of the adjusted contract amount is earned, one hundred (100) percent of the "Initial Mobilization Payout" will be paid. Previous payments under this item will be deducted from this amount.

F. Payment for the remainder of Pay Item “Total Mobilization Payment” will be made upon receipt of the final pay estimate.

Payment will be made under:

   "Total Mobilization Payment"   Lump Sum

End
ITEM NO. 703
FENCING FOR EXCAVATIONS

703.1 Description
This item shall consist of temporary safety fencing supported on posts and constructed of materials as indicated and removed when excavation is backfilled.

703.2 Materials
(1) Fabric
   (a) Fabric to be 4 feet in width, made of high density polyethylene resin, extruded and stretched to provide a highly visible international orange, non-fading fence which will remain flexible from -60° F to 200° F, and be inert to most chemicals and acid. Pattern may vary from diamond to circular with a minimum weight per foot of 0.4 lbs./Ft., a 4 foot width minimum tensile yield strength (Horiz.) of 2000 psi, ultimate tensile strength of 2680 psi (Horiz.) and a maximum opening no greater than 2 inches.

(2) Metal Posts
   Steel pipe, tee posts, U posts or 2" x 4" timber posts, 5½ feet in length minimum, spaced no more than 8 feet on centers. Fabric to be secured to post by bands or wire ties.

703.3 Construction Methods
Prior to commencing construction suitable "Barricades, signs and traffic handling" devices shall be installed to protect workers and public. Safety fencing shall be erected to lines and grades indicated. Excavations within 750 ft. of schools or day care centers require special attention by Contractor to secure entry while work is in progress. Fence shall be installed prior to excavation and maintained until excavation is backfilled. Fence shall be placed a minimum of 4 feet from edge of excavation. Posts shall be driven in ground a minimum of 18 inches. At completion of each day's work, safety fencing shall be pulled taut, and entry secured. When safety fence is no longer needed, Contractor shall remove fence and posts and patch any damage to surfaces.

703.4 Measurement
Safety fencing shall be measured by linear foot of fence measured along ground; gates will not be measured separately.

703.5 Payment
Work performed and materials furnished as prescribed by this item, measured as provided under "Measurement", shall be paid for at the unit price bid for "Safety Fencing" which price shall be full compensation for furnishing, installing and removing safety fencing and gates, including posts, bands or ties, and for manipulations, labor, tools, equipment and incidentals necessary to complete the work, removal and patching damaged surfaces.
Payment will be made under:

Safety Fencing - Per Linear Foot

End

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SECTION 1800
CONSTRUCTION REQUIREMENTS AND PROCEDURES

General
This series and the technical specifications of the City of Round Rock Standard Specifications shall govern the construction by an entity other than the City of public infrastructure that is related to a subdivision or site development located within the City of Round Rock and within subdivisions assigned for City of Round Rock inspection within its extraterritorial jurisdiction, as well as the acceptance by the City of Round Rock, of work completed within the City’s limits.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

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SECTION 1802
DEFINITION OF TERMS

1802.1 Definitions
Whenever the following terms or pronouns used in place of them appear in the Contract Documents, the intent and meaning of the terms or pronouns shall be interpreted as follows:

1802.2 The City or City of Round Rock
The City of Round Rock, Texas.

1802.3 The Owner/Developer
The Owner/Developer of the development or the person in the financial entity (e.g., bank, credit corporation, etc.) liable for its existence or their duly designated representative who can authorize construction.

1802.4 The Consulting Engineer
The Engineer of the Owner/Developer or the Consulting Engineer's duly designated representative, who is authorized to make design decisions for the Owner/Developer. The Consulting Engineer must be a Licensed Professional Engineer Registered in the State of Texas.

1802.5 The City Engineer
The Director of the Engineering and Development Services Department of the City of Round Rock or his/her duly authorized representative, who makes all decisions as to quality of the project and conformance of the Work for final acceptance by the City.

1802.6 The Chief Construction Inspector
The City Engineer's representative in responsible charge of the Construction Inspection Division of the Engineering and Development Services Department.

1802.7 The Contractor
The individual, firm, corporation or other business entity that is contracted to complete the Work for the Owner/Developer.

1802.8 License Agreement
An agreement between the City of Round Rock and another entity for private use of public property.

1802.9 The Work
The Work shall include the furnishing of all labor, materials, equipment and other incidentals necessary for the successful completion of all items required by The Contract Documents and the completion of all the duties and obligations included therein.
1802.10 The Contract Documents
The Contract Documents are the Specifications and, the Drawings that have been prepared by a Licensed Professional Engineer, Registered in the State of Texas, have been approved by the Owner/Developer for the work, and for which a Development Permit has been issued by the City.

The Contract Documents are complementary and what is required by any one of them shall be as binding as if required by all. In case of conflict between the Contract Documents, priority of interpretation shall be in the following order: Specifications (1802.11), the Drawings (1802.12), and Construction Requirements and Procedures (1802.16).

1802.11 The Specifications
The directions and conditions contained in the technical specifications of the City of Round Rock Standard Specifications, supplemented by changes pertaining to method and manner of performing The Work or to qualities of materials to be furnished as presented by the Consulting Engineer and accepted by the Engineering and Development Services Department. The entire technical specifications shall apply to the Work. Any question as to the applicability of any individual technical specifications shall be determined by the City Engineer. Where phrases “directed by”, “in the opinion of”, “unless otherwise approved by”, “approved by”, “may be varied by”, “to the satisfaction of” or such similar phrase accompany a phrase similar to “The Engineer or designated representative”, it is to be understood that such direction, opinion, approval, variation, or satisfaction is subject to the approval of the City Engineer. Where reference is made to specifications of ASTM, AASHTO, TxDOT, etc., it shall mean the latest standard or tentative standard in effect on the date of the city signature authorizing construction, unless another date applies pursuant to State statutes.

1802.12 The Drawings
The Drawings accepted by the City Engineer (and the Development Review Committee (DRC) of the City for site development) or true reproductions thereof, which show locations, character, dimensions and details of the Work.

1802.13 The Development Review
A function of The Engineering and Development Services Department and the Development Review Committee (DRC) of the City in the review and acceptance process for subdivision and site development Drawings.

1802.14 The Development Permit
Valid signature(s) on the drawing which indicates that the Drawings for the development of a subdivision have been accepted by the Engineering and Development Services Department, and for site development, the Engineering and Development Services Department and the Development Review Committee (DRC) of the City.
1802.15 The Engineering and Development Services Department (E&DS)
The specific department of the City of Round Rock which is responsible for ensuring that public improvements associated with a subdivision and/or private development are constructed in accordance with the Contract Documents.

1802.16 Construction Requirements and Procedures
Detailed instructions set forth in this section delineating the responsibilities of the Owner/Developer for proper prosecution of the Work and the functions to be followed by the Engineering and Development Services Department in the inspection and acceptance of functionally completed Work.

1802.17 Sequence of Construction
The order in which the Work is to be accomplished.

1802.18 Written Notice
A Written Notice will have been duly served: if delivered in person to the Owner/Developer or a principal or employee of the firm authorized to make decisions for the Owner/Developer, if hand delivered or submitted through facsimile transmission to an office of the corporation for whom it is intended, or if delivered to or forwarded by certified, registered mail to the last business address known to the party giving notice.

1802.19 The Superintendent
An English-speaking representative of the Owner/Developer or the Contractor with relevant experience and knowledge of construction work related to the type of infrastructure development authorized by the Development Permit. The superintendent shall supervise and direct the construction and shall be the person authorized to receive and respond to communications from the City Engineer and the Inspector.

1802.20 The Inspector
The authorized representative of the Engineering and Development Services Department assigned to inspect and observe testing of any or all parts of the Work and materials used therein. He/she is also a member of the Construction Inspection team under the direction of the Chief Construction Inspector.

1802.21 Laboratory
A laboratory, which is certified in accordance with ASTM E-329 by a nationally recognized certifying authority, and is approved by the Chief Construction Inspector.

1802.22 Qualified Products List
A listing of manufactured products of like kind that are used by city forces in maintenance of Water and Wastewater Utility Installations and Facilities.
1802.23 Abbreviations

The following is a list of the more commonly used abbreviations and do not compose a complete listing of all abbreviations. If an abbreviation is used that a person is unfamiliar with or does not immediately recognize, the person may contact the Engineering and Development Services Department of the City of Round Rock for the appropriate full, formal name associated with the abbreviation.

AASHTO American Association of State Highway and Transportation Officials
ADA Americans With Disabilities Act
ANSI American National Standards Institute
APWA American Public Works Association
ASTM American Society for Testing and Materials
AWWA American Water Works Association
USCE Corps of Engineers (U.S. Dept. of the Army)
FM Factory Mutual System
ITTE Institute of Traffic and Transportation Engineers
TMUTCD Texas Manual on Uniform Traffic Control Devices
TxDOT Texas State Department of Transportation
TEX TEST TxDOT Laboratory Test
TCEQ Texas Commission for Environmental Quality
UL Underwriters Laboratory

End
SECTION 1803

RESPONSIBILITIES OF THE OWNER AND CONSULTING ENGINEER

1803.1 The Owner/Developer - Consulting Engineer Relationship
The Owner/Developer shall specify in writing his representative(s) for the Work who will be responsible for all communications with the City. Once the Contract Documents have been accepted by the Engineering and Development Services Department (E&DS), and submitted to the Construction Inspection Division of the E&DS for inspection, the Work must not deviate from the Contract Documents, unless supported by a Revision submitted by the Consulting Engineer and accepted as a revision by the E&DS. Minor field adjustments, which do not affect project integrity, are consistent with the intent of the design and are approved by the Chief Construction Inspector or City Engineer may be allowed by the Inspector. The Owner/Developer may effect revisions through the E&DS, which will forward copies of accepted revisions to the Construction Inspection Division.

Only the City Engineer may accept the Work as complete for the City of Round Rock. This acceptance will be exercised only after the City Engineer or designated representative is satisfied that the Work complies with the Contract Documents.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

1803.2 The Owner/Developer's Duty and Superintendence
The Owner/Developer shall be responsible for the requirement that the Contractor provide a competent English-speaking Superintendent, knowledgeable in the Work involved, and necessary assistants to supervise and direct the Work during its progress. The Owner/Developer shall insure that the Contractor shall do no work nor use materials at the site without qualified supervision by the Contractor and inspection of the Work by the City. The Owner/Developer shall require the Contractor to immediately comply with "Stop Work Orders" commonly referred to as 'Red Tag' violations.

1803.3 Authority and Duties of the Inspectors
The Inspectors will be authorized to inspect all work undertaken by the Contractor and all materials furnished to the site and shall be given ingress and egress to all areas of the Work. Inspection activities may extend to all or to any part of the Work and to the preparation or manufacture of the materials to be used on the site. The Inspector will be assigned to the Work, will document/inspect the progress of the work and the manner in which it is being performed and will advise the Contractor and Owner/Developer of any obligations to perform the Work in accordance with the requirements of the Contract Documents. The Inspector will also report to the Chief Construction Inspector or City Engineer whenever it appears that the materials furnished and the Work performed by the Contractor fail to fulfill the requirements of the Contract Documents.
In case of any dispute arising between the Contractor and the Inspector concerning materials furnished or the performance of the Work, the Inspector will issue to the Owner/Developer and the Contractor a Notice of Unacceptable Work, which will remain in effect until the Work is corrected or the question at issue can be resolved by the Owner/Developer under item 1803.14, Objections. The Inspector will not be authorized: (1) to revoke, alter, enlarge or release any requirement of the Contract Documents; (2) to approve or accept any portion of the Work or (3) to issue instructions contrary to the Contract Documents. The Inspector will in no case act as foreman of the Work, perform other duties for the Contractor, or interfere with the management of the Work.

The presence of an Inspector on the site shall not relieve the Owner/Developer and the Contractor from full compliance with the Contract Documents,

1803.4 Pre-construction Conference

A Pre-construction Conference will be held prior to the start of construction on the Work. The Owner/Developer will provide E&DS the number of sets of prints required by E&DS of accepted Drawings for distribution before a Pre-construction Conference is scheduled.

In those cases where the Owner/Developer of a Project is allowed to amend his Work to undertake rough-cut or rough-cut/utility work on a portion of the Project, a pre-construction conference shall be held for the rough-cut or rough cut/utility and associated work and an additional pre-construction conference must be held after a full development permit has been obtained. Drawings must be delivered at both the rough-cut and full development phases.

The date and the time for the Pre-construction Conference will be established by the Inspector with the concurrence of the Consulting Engineer but in no case more than four (4) days after request and receipt from the Owner of the Drawings. An agenda will be prepared by the Consulting Engineer who will conduct the Conference and record and distribute Conference minutes and will include, as a minimum, discussion of the following items:

Introduction of all parties with an exchange of phone numbers and addresses;
Accepted plans and required permits;
Discussion of start dates and target completion dates;
Notification to City for inspection and testing;
Erosion control system, violations and “Red Tags”;
Traffic control and barricade system approved by the Consulting Engineer (2 copies shall be provided to the Inspector);
Submittals approved by the Consulting Engineer for all materials scheduled for the Work, including but not limited to: pipe, manholes, valves, hydrants, fittings, rebar, R.C.P., base, bedding, and subgrade prep. (2 copies shall be provided to the Inspector);
TCEQ requirements;
City accepted material submittals (SPLs, flexible base, p.c. concrete, hot mix asphalt concrete, etc.);
Construction sequencing and phasing;
Utility conflict notice;
Trench safety plan approved by the Consulting Engineer and proof of insurance (2 copies shall be provided to the Inspector);

Sequence of Construction
Survey cut sheets (2 copies shall be provided to the Inspector);
Backfill procedure and compaction of trenches;
Hydrant maintenance by the Contractor;
Asphalt Supplier;
Concrete Supplier;
Base Supplier;
Subcontractors;
Dry Utilities (2 copies of plans shall be provided to the Inspector);
Landscaping Agreements;
Geotechnical Report (2 copies shall be provided to the Inspector);
Subgrade Inspection by the Geotechnical Engineer;
Flushing meter;
Re-vegetation and Developer’s Contract;
Final clean-up and punch list;
Maintenance and warranty bonds;
Final walk-through and acceptance.

A minimum of two days notice of the conference will be given by the Consulting Engineer to the following:
Owner/Developer,
County Representative, as appropriate,
Water and Wastewater,
The Electric Company,
The Gas Company,
Reviewer for E&DS
Other Utilities and Parties, as appropriate.
The Owner/Developer will provide notice to the Contractor. The Pre-construction Conference is mandatory for the Owner/Developer, the Consulting Engineer, and The Contractor.

1803.5 On-Site Pre-construction Meeting
After or in conjunction with the Pre-construction Conference and before the Work begins, an on-site meeting shall be held to review erosion and sedimentation controls. As a minimum the meeting shall include the following individuals:
The Contractor and the Superintendent,
The Inspector assigned to inspect the Work,
The Consulting Engineer.

The inspector will be provided with a minimum of 24 hours notice to establish a meeting date and time. If the inspector does not establish a date and time for the meeting within three working days of receiving the notice, construction may proceed.
1803. 6 Inspection Notifications

After the Pre-construction Conference, the Contractor must provide a minimum forty-eight hour advance notice of intent to begin the Work. Other circumstances may require additional time for notification when agreed to by the City Engineer or designated representative.

There are various stages of construction for which the Inspector shall be given the choice of inspecting and observing testing either before, during or after the operation. The actual stages of the various items are too numerous to itemize in complete detail or define the absolute advance notification time required by an Inspector.

Circumstances requiring advance notification include, but are not limited to:

1. The Inspector shall be given 24 hours advance notice for a major item, such as excavation, embankment, placement of pipes, backfill, processing of base material, placement of curb and gutter, placement of structures, placement of p.c. concrete, lay down of asphalt concrete or when the construction of drains is under way. The Inspector will follow up at time intervals to be established by the Inspector. If the Work is stopped for any reason, (i.e., weather, strike, lack of materials, equipment break downs, etc.) for 7 or more calendar days, the Inspector shall be notified 24 hours in advance of any Work starting back up. Because of work load, the Contractor shall coordinate with the Inspector when more than two hours of the Inspectors time is required on any given day for the purpose of observing testing.

2. The Inspector shall be given 24 hours advance notice when the Contractor anticipates each blue top/density stage, subgrade approval for base, base approval for a succeeding course of base, base approval for prime coat and placement of asphalt concrete.

3. A Job Mix Formula for asphalt concrete as approved by the Consulting Engineer, must be provided to the Inspector for review and acceptance a minimum of three days before asphalt paving is planned. Notification shall be given to the Inspector a minimum of 24 hours before the initiation of asphalt concrete paving. This review and notification must be accomplished for asphalt concrete to be acceptable to the City of Round Rock.

4. A Portland Cement Concrete Mix Design as approved by the Consulting Engineer, shall be provided to the Inspector for review and acceptance a minimum of 3 days before the proposed concrete placement. The inspector shall be notified at least 24 hours before the concrete is placed to allow the scheduling of on-site inspection of reinforcing steel, waterstops and other related components.

5. The Contractor shall request permission from the Inspector and Chief Construction Inspector as far in advance as practicable but no less than 72 hours in advance to perform any work on Saturdays, Sundays or City of Round Rock holidays. Installation of pipes, conduits, and
appurtenances or any other work requiring the presence of the Inspector shall not be performed on Saturdays, Sunday or CORR holidays without specific permission from the Chief Construction Inspector. Any Work accomplished without permission will not be acceptable to the City.

6. The Contractor shall contact the appropriate "One Call" Center for the location of existing utilities prior to the beginning of any Work.

1803.7 Lines and Grades
All lines, grades and control measures shall be furnished, checked and/or replaced as necessary by the Owner/Developer. The Contractor shall provide assistance, as necessary, to conduct these checks. Whenever necessary, construction shall be suspended to permit the performance of this Work and to allow the Inspector to review and check, if necessary, these procedures. Suspension will be as brief as practical. Four (4) copies of "Cut and Fill" sheets or other approved provisions for line and grade control for road, bridges, water and wastewater lines, storm sewer and other drainage structures or systems, along with required certifications shall be delivered to the Consulting Engineer for distribution (2 copies shall be provided to the Inspector). The sheets shall be certified by a Licensed Professional Engineer Registered in the State of Texas or a Licensed Professional Land Surveyor Registered in the State of Texas. Minimum staking requirements for roadways, bridges, water and wastewater lines, storm sewers and channels are as follows:

A. Roadways:
   1. Offset hubs must be provided on both sides of the roadway
   2. Straight grades at 50 feet (15 meters) maximum spacing with transverse quarter points.
   3. Vertical curves at 25 feet (7.5 meters) maximum spacing with transverse quarter points.
   4. BC, EC and stations of vertical curves with elevations.
   5. PC, PT and stations of horizontal curves with elevations.
   6. Horizontal curves at 25 feet (7.5 meters) maximum spacing with transverse quarter points.
   7. Both ends, offsets and transitions of curb inlets.
   8. High and low points of vertical curves.
   9. Grade breaks.
   10. Islands - all of the above points.
   11. Separate subgrade cut sheets are not needed.
   13. Slope stakes for top and toe of slopes.

B. Storm Sewers:
   1. Every 50 lineal feet [15 meters] maximum spacing.
   2. Grade breaks with elevations.
   3. PI, forward and backward tangents for horizontal curves.
   4. Horizontal curves at 25 feet (7.5 meters) maximum spacing.
   5. PC and PT stations for horizontal curves.
   6. Flow lines into and out of manholes, junction boxes and splitter boxes.
7. Tie-in to existing storm sewers.
8. Flow line of storm sewer and channel where they intersect.
9. Double stake ends of storm sewer
10. Headwalls

C. Channels:
1. Every 50 lineal feet (15 meters) maximum spacing.
2. P.I., P.C., P.T., stations of all horizontal curves.
3. Horizontal curves, 25 feet (7.5 meters) maximum spacing.
4. All offsets to centerline of channel.
5. Flow line of storm sewer and channel where they intersect.
6. Grade breaks with elevations.
7. Dissipators - break points, beginning and end.

D. Water Pipelines:
1. Every 50 lineal feet (15 meters), maximum spacing.
2. PI, PC, PT, PRC, PCC and stations of horizontal curves.
3. Horizontal curve stations at 25 feet (7.5 meters) maximum spacing.
4. Reference all offsets to the centerline of pipe.
5. Tie-in both ends to existing pipe.
6. Vertical PI stations with elevations.
7. “Cut and Fill” sheets are not required for water lines less than 12" (300 mm) inside diameter (ID).
8. Pipe lines 12" (300 mm) ID and larger will be laid out according to pipe layout plan if required by the technical specifications.
9. Where the pipe layout plan indicates a straight pipe section with no grade change it is permissible to layout every 50 feet (15 meters).
10. All pipe joint deflections along vertical and horizontal curves and angle points with elevations.
11. All points along the construction staked line will have a hub driven in the ground with a known elevation obtained from a USGS reference datum.
12. All structures and appurtenances shall be staked at beginning, end and any intermediate point deemed necessary.

E. Wastewater Pipelines:
1. Every 50 lineal feet (15 meters) maximum spacing.
2. Grade breaks.
3. Inlets and outfalls of all manholes.
4. Forward and backward tangents of horizontal curves.
5. Horizontal curves at 25 feet (7.5 meters) maximum spacing.
6. PC, PT, PCC, PRC stations of horizontal curves with elevations.
7. All offsets referenced from the centerline of pipe.
8. All points along the construction staked line will have a hub driven in the ground with a known elevation obtained by U.S.G.S. reference datum.
9. All structures and appurtenances shall be staked at beginning, end and any intermediate point deemed necessary.

Each point or station on a “Cut or Fill” sheet shall have a hub set and identified on the ground.
1803.8 Construction Drawings
The Owner/Developer will forward the number of copies required by E&DS of the accepted subdivision or site development plans and approved revisions of the plans and the specifications to the E&DS. The date upon which the City initially accepted the plans by signature shall be the date used to determine expiration of the plans as per Chapter 8 or Chapter 11 of the City Code of Ordinances.

1803.9 Shop Drawings and Submittals
All sample submittals, shop drawings, setting drawings, and schedules required for the work of the various trades by the Contract Documents will be submitted by the Contractor to the Consulting Engineer. The Consulting Engineer shall review, identify any required corrections, revise the Drawings if required, and inform the Contractor of the status of the shop drawings. Upon approval of the shop drawings and/or submittals, the Consulting Engineer shall forward two (2) copies to the Inspector. Any work requiring a shop drawing or sample submittal shall not proceed until approved Submittals/Drawings have been received by the Inspector.

1803.10 Preliminary Approval
The City Engineer and the Owner/Developer shall not have the power to waive: any obligations of the Work; the furnishing of good material by the Contractor; or the performance of good work as herein described. The Work shall be in complete accordance with the Contract Documents. The failure or omission on the part of the City Engineer to discover, identify or condemn any defective work or material shall not release the Owner/Developer from the obligations to fully and properly complete the Work including without limitations, the obligation upon the discovery of said defective work or material to at once remove and properly replace the defective work or material at any time. The City Engineer shall, upon request of the Contractor or Owner/Developer, inspect and accept or reject any material furnished for the Work. Once the material has been accepted by the City Engineer, the acceptance shall be binding on the City of Round Rock, unless it can clearly be shown that the identified material has changed in character to the extent that it does not meet the specifications for the Work.

Any specific item of the Work, which is in dispute and has been issued a Notice of Unacceptable Work, may be re-examined by the City Engineer at any time prior to final acceptance. If found to be not in accordance with the Contract Documents for any specific item of the Work, all expense for removal, re-examination and replacement shall be borne by the Contractor and/or Owner/Developer. When inspection or approval is specifically required by the Specifications prior to performance of certain work or subsequent stages of the Work and the Contractor proceeds with such work without requesting prior inspection or approval, the Contractor and/or Owner/Developer shall bear all expenses of demolition, removal, and replacement of the work if so directed by the City Engineer.

1803.11 Defects and Their Remedies
If any material, either selected for the Work or delivered on the site for use in the Work, shall be deemed by the City Engineer to be unsuitable or not in conformity with the
Contract Documents, or the intent thereof, the Owner/Developer and the Contractor shall be notified by the City Engineer in a written notice which identifies and/or describes the unacceptable material. The Owner/Developer, after receipt of written notice from the City Engineer, shall then require the Contractor to immediately remove such material from the jobsite and rebuild or otherwise remedy any affected work so that it shall be in full accordance with the Contract Documents.

1803.12 Initial Determinations
The Consulting Engineer and/or the Owner/Developer shall determine all claims, disputes and other matters in question between the Contractors and the Owner/Developer relating to the execution or progress of the Work or the interpretation of the Contract Documents. If, in the opinion of the Consulting Engineer, the resolution results in a proposed change in the Contract Documents, appropriate revisions will be submitted to the appropriate plan review department for review and acceptance and delivered to the Inspector before the Work proceeds.

The City Engineer or his/her authorized representative will be the final authority for the interpretation of the Specifications.

1803.13 Objections
In the event the City Engineer or his representative renders any decision which in the opinion of the Owner/Developer or the Consulting Engineer is not in accordance with the meaning and intent of the Contract Documents, and the Owner/Developer or the Consulting Engineer is unable to resolve the matter with the Inspector assigned to the Work, or the Chief Construction Inspector, then the Owner/Developer may submit a written objection to the decision explaining why the decision is not in accordance with the Contract Documents to:

Chief of Public Works Operations
City of Round Rock
2008 Enterprise
Round Rock, Texas, 78664

A copy of the objection shall be sent to the City Engineer.

The Chief of Public Works Operations will resolve the appeal within five working days of its receipt (excluding weekends and City of Round Rock holidays.

End
SECTION 1804
GENERAL OBLIGATIONS AND RESPONSIBILITIES

1804.1 Keeping Construction Documents Accessible
The Owner/Developer will require the Contractor performing the Work to maintain on the work site a minimum of one complete copy of the Contract Documents including the latest as built revisions to the Drawings. The Contract Documents shall be accessible to representatives of the City Engineer, the Owner/Developer and the Consulting Engineer at all times.

1804.2 Adequacy of Design and Construction
It is understood that the Owner/Developer believes that he has employed competent Consulting Engineers. The Owner/Developer, therefore, shall be responsible for the adequacy of the design, compatibility of the Contract Documents, safety of all structures and construction procedures, and the practicability of operations of the completed Work. The burden of proof of such compliance shall be the responsibility of the Owner/Developer by demonstrating that he/she has complied with all requirements of the Contract Documents, along with all approved additions and alterations to the Contract Documents.

If during the Warranty Period following final acceptance by the City of Round Rock, the Work exhibits: (a) damage, deterioration, distress and/or failures; (b) requires excessive maintenance or rehabilitation work due to defects in materials, products or workmanship including utility backfill; and/or (c) design inadequacies are uncovered and identified, the Owner/Developer shall be notified of these conditions by the E&DS. The Owner/Developer shall take the corrective action(s) within 10 calendar days, which is (are) accepted by the City Engineer or designated representative. The City Engineer will suspend or revoke any new development or building permits by the Owner, until the deficiency (or deficiencies) of the Work is (are) satisfactorily corrected.

1804.3 Materials and Workmanship
Unless otherwise specified, the materials and equipment furnished for permanent installation in the Work shall conform to all applicable requirements of the Contract Documents and shall be new, unused and undamaged when installed or otherwise incorporated in the Work. When an article of material or equipment is specified by definitive description, or identified only by using a proprietary name or name of a particular manufacturer or vendor, such description/name shall be accepted as establishing the type, function, class and quality of product specified. The Owner/Developer through the Contractor or the Consulting Engineer shall submit descriptive information and evidence to the City Engineer or designated representative that the materials and equipment, proposed by the Contractor for incorporation in the Work, is of the kind, capacity and quality that satisfies the specified types, functions, classes and quality.

The Water and Wastewater Utility Standard Products Lists (SPLs) form a part of the Contract Documents. When the Contractor elects to use any materials/products from the Standard Products Lists, the materials/products shall be clearly and completely
identified when submitted for use in the Work. Any material/product, which is proposed for use in the Work, shall be submitted to the Consulting Engineer and the Inspector for review and approval prior to the use and/or incorporation of the material/product in the Work.

The City of Round Rock Standard Specification Item 340, "Hot Mix Asphaltic Concrete Pavement" and Specification Item 360, "Concrete Pavement", provide for the option of possible acceptance of pavements, which do not fully meet all specified requirements. If the reduced-standard pavements are otherwise acceptable in accordance with Standard Specifications 340 or 360 and to the City Engineer or designated representative, then the Owner Owner/Developer or the Contractor may, with the concurrence of the City Engineer, request that the Work be made acceptable by providing a cash payment to the City. The dollar amount shall be calculated by reducing the base value of standard pavements by the percentages established by factors incorporated in Standard Specification items 340 for asphalt pavements and 360 for concrete pavements. The base values for standard pavements shall be determined by the City Engineer from the average costs for concrete or asphalt pavement construction, respectively, in previous years under contract to the City. The amount of cash payment shall be the amount of the dollar reduction.

1804.4 Testing of Materials
Unless otherwise specified, all on site testing to establish the quality of material to be incorporated in the Work will be as required by the City Engineer or designated representative. The frequency, time, locations and testing procedures will be coordinated with the Inspector. The testing shall be accomplished by an independent laboratory, which is acceptable to the City Engineer. Payment for all initial testing will be the responsibility of the Owner/Developer. Payment for retesting shall be the responsibility of the Contractor. Restoration or patching required as a result of the testing shall be at the expense of the Contractor.

The extent of investigations and retesting, related to unacceptable and/or failed tests shall be determined by the City Engineer. The City Engineer may require a minimum of two passing retests for each failure before acceptance will be made by the City.

The manufactured materials to be incorporated in the Work shall meet the requirements of the Contract Documents (e.g., reinforcing steel, expansion joint materials, concrete pipe, cement, miscellaneous steel, cast iron materials, flexible base, etc.). The Owner/Developer may be required to furnish a manufacturer's certificate stating that material meets the requirements specified for the Work.

1804.5 Sidewalk Variance
If grading for sidewalks during construction will damage, adversely impact or remove desirable natural features, trees etc., the Owner/Developer may request a variance from the E&DS for the realignment of the sidewalk. The Consulting Engineer shall submit a plan which includes detailed grading, elevation and alignment information in the vicinity of natural features, shall certify that no utility lines, inlets, meters or castings will be affected and request an appropriate change in the Work.

When the sidewalk plan requires an easement outside of public right of way and E&DS
concurs, the Consulting Engineer shall provide an easement signed by the appropriate property owner dedicating an easement to the public. The dedication document will be accompanied by a sketch and metes and bounds description, certified by a Licensed Professional Land Surveyor Registered in the State of Texas, which is ready for recording. Submittal of this instrument is required before final acceptance can be issued by the City.

The Consulting Engineer shall record all sidewalk variances on reproducible Record Drawings and submit the drawings to E&DS as part of the as-built Drawings.

1804.6 License Agreements
When construction of the development includes retaining walls, landscaping, other privately owned improvements or provisions for future construction of these facilities within the public right-of-way, the Owner/Developer must have secured an executed License Agreement prior to final acceptance of the Work.

1804.7 Street Signs
The street name signs at signalized intersections shall be provided to the City by the Owner. All traffic control and street name signs at unsignalized intersections within and abutting the subdivision shall be installed by the Owner/Developer. The sign locations shall be based on guidelines provided in the most recent version of the State of Texas Manual on Uniform Traffic Control Devices.

1804.8 Laws and Ordinances
The Owner/Developer and the Contractor shall observe and comply with Federal, State and local laws, ordinances and regulations, which in any manner affect the Work. The Owner/Developer and the Contractor shall defend, indemnify and hold harmless the City and its respective officers, agents and employees from and against all damages, claims, losses, demands, suits, judgments and costs, including reasonable attorneys fees and expenses, arising from the violation of any such laws, ordinances and regulations whether effected by the Owner/Developer, the Contractor or their employees.

1804.9 Force Majeure
If the Owner/Developer, the Contractor or the City is prevented from performing all or a part of the Work or any duties related thereto: (a) as a result of fire or other calamity; (b) by order of a governmental authority at the Federal, State or Local level; (c) by acts of God, strikes, lockouts or other industrial disturbances; (d) by acts of public enemies, material or labor restrictions by governmental authority; (e) by civil riot, flood as determined by the appropriate governmental authorities or (f) by acts of the Owner/Developer or any cause beyond the reasonable control of the Owner/Developer, the Contractor and/or the City; then the party suffering the “Force Majeure” shall notify the City in writing within five days of the onset of the condition of the “Force Majeure”, excusing said performance and indicating the nature, extent, and probable duration of the “Force Majeure” condition. The suffering party shall then take all steps, reasonable, to resolve the condition during its pendency and shall notify the other parties immediately upon the resolution of the condition of “Force Majeure”.

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Series 1800 - Private Development

22 Construction Requirement & Procedures
If the condition of “Force Majeure” extends to 20 calendar days of endurance, the Owner/Developer, the Contractor and the City shall agree to meet and discuss a resolution to preserve the interests of the respective parties in the Work. However if all respective parties agree, a resolution meeting may be scheduled for any time less than twenty (20) days.

End
SECTION 1805
PROTECTION OF PERSONS AND PROPERTY

1805.1 Safety Precautions and Programs
The Owner/Developer shall be responsible for initiating and maintaining all safety precautions and programs in connection with the Work.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

1805.2 Safety of Persons and Property
The Owner/Developer shall undertake and shall require the Contractor to undertake all reasonable precautions for the safety of and shall provide all reasonable protection to prevent damage, injury or loss to:

1. All employees on the Work and all other persons who may be affected thereby;
2. All of the Work and all materials and equipment to be incorporated therein, whether in storage on-site, under the care, custody or control of the Owner/Developer, the Contractor or any Subcontractors; and
3. Other property at the site, including trees, shrubs, lawns, walks, pavements, fences, roadways, structures, and/or utilities not designated for removal, relocation or replacement in the course of the construction.

The Owner/Developer shall and shall require the Contractor to comply with all applicable laws, ordinances, rules, regulations and lawful orders of all public authorities having jurisdiction for the safety of persons or property or to protect them from damage, injury or loss. The Owner/Developer shall be responsible for: (a) the erection and maintenance of all reasonable safeguards for safety and protection, as required by existing conditions and progress of the work, including the posting of danger signs and other warnings against hazards; (b) promulgating safety regulations and (c) notifying owners of adjacent utilities of potential dangers caused by this work.

1805.3 Protection of Adjoining Property
The Owner/Developer shall be responsible for and shall require the Contractor to undertake proper means to protect the adjacent or adjoining property or any private properties, encountered in any way, which might be injured or seriously affected by any process of construction of the Work from any damage or injury by reason of said process of construction. The Owner/Developer shall be liable for any and all claims of such damage on account of the Owner/Developer’s failure to fully protect all adjoining property or any properties encountered in any way. The Owner/Developer shall agree to indemnify, save and hold harmless the City of Round Rock its agents and employees against any claim or claims for damages due to any injury to any adjacent or adjoining property arising or growing out of the performance of the Work regardless of whether or not the damage or injury is caused in part by a party indemnified hereunder.
1805.4 Public Safety and Convenience

The safety of the public shall be regarded as of prime importance. All portions of the existing public streets adjacent to the Work shall be kept open and shall provide a smooth, safe and comfortable ride to the traffic. It shall be the responsibility of the Owner/Developer to ensure that two-way traffic may safely bypass the construction site and that access is provided to abutting private property. If the street is a one-way street, the Owner/Developer shall ensure that one lane of travel remains available. Closing of existing public streets or lanes shall be subject to the approval of the City Engineer.

The Owner/Developer shall require the Contractor to plan and execute its operations in a manner that will cause the minimum interference with public traffic and shall require that the Contractor place and maintain in good condition standard barricades at each and all entrances to the Work and at other locations where traffic is rerouted or blocked from using regular public traffic lanes. Barricades and warning signs shall be installed in accordance with the latest edition of The State of Texas Manual on Uniform Traffic Control Devices.

The Owner shall require the Contractor to notify, request and receive approval from the City at least four (4) days (excluding Saturdays, Sundays or Holidays) in advance of the intention to close or partially block a public roadway or any part thereof located within the City or any construction, which may affect the free flow of public traffic. If the public roadway or any portion thereof is not located within the City, then notification and approval for closure shall be received from the appropriate city, county and/or state representative.

In the event the Contractor’s operations reduce an existing public two-way roadway to less than 20 feet (6 meters) in width, the Contractor shall provide flaggers and shall route traffic through the construction area one lane at a time. A flagger will be required any time it is necessary for construction equipment to move into or across a public traffic lane or at such other times as directed by the Consulting Engineer and approved by the City Engineer. A flagger shall be utilized to aid the exit of construction equipment from public traffic lanes to the work area and the entry of construction equipment from the work area to public traffic lanes. Flaggers will be properly dressed and operate in accordance with the latest edition of The State of Texas Manual on Uniform Traffic Control Devices.

Barricades and signs with flashers shall be erected at each and every entry to the Work to notify and warn the public that the area is under private construction and should be entered only at their own risk. ReflectORIZED regulatory signs shall be installed on each side of each and every entry road in the right-of-way with the legend, "Private Road, Enter at Own Risk". The signs shall be the size and color combination indicated for sign R-11-2 of the latest edition of The State of Texas Manual on Uniform Traffic Control Devices and shall be mounted on Type III barricades. If there is insufficient room in which to place the Type III Barricade, two nominal 4x4 inch (100x100 mm) posts may be used for the installation of the sign in lieu of mounting the sign on a barricade. A standard stop sign shall be installed on the right side of each existing roadway at its point of intercept with a public roadway.
These barricades and signs shall be maintained in a clean and good condition until the Work is accepted by the City of Round Rock, when all but the stop signs may be removed by the Owner/Developer. If at any time during the performance of the Work the Owner/Developer allows these traffic control measures to deteriorate to a condition unacceptable to the City Engineer, the Owner/Developer will be issued a Written Notice to repair or replace the traffic control measures. If the conditions remain the same or worsen within 1 hour after the Written Notice has been served, the City Engineer may authorize City of Round Rock personnel or private contractual personnel to restore the barricades, signs and flashers to a safe condition. Continued neglect by the Owner/Developer may result in the suspension of permits, issuance of ‘Red Tags’ and/or initiation of legal restraints. The Owner/Developer will be required to make monetary restitution for City personnel or contractual costs for the restoration of the barricades, signs and/or flashers to a safe condition before the City of Round Rock will make final acceptance.

1805.5 Location and Protection of Utilities
The Owner/Developer and the Contractor are solely responsible for the location and protection of any and all public utility lines and utility customer service lines in the work area. The Contractor shall exercise due care to locate, mark, uncover or otherwise protect all such lines in the work area.

Neither the Owner/Developer nor the Contractor shall begin work in the area until the appropriate One-Call Center has been notified, a One-Call Notification Number issued and the Owner and/or the Contractor can assure that the locations of all lines and utilities have been marked.

Upon request, utility owners shall provide available information on the location and grade of water, wastewater, gas, storm sewer, and telephone and electric lines and other utilities in the work area. The presence of such information, however, shall not relieve the Owner/Developer or the Contractor of the obligations hereunder, which shall be primary and non-delegatable. Any such lines damaged by Contractor’s operations shall be immediately repaired by the Contractor upon the concurrence of the repair of the utility; or the Owner/Developer shall cause such damage to be repaired at his expense.

1805.6 Public Right of Way Cut Permits
The use of City or County streets, sidewalks and other public easements by the Owner/Developer and/or the Contractor shall be subject to and in accordance with City or County ordinances, policies, standards and procedures governing said use of streets, sidewalks and public easements. The Owner/Developer’s or the Contractor’s use of City or County streets, sidewalks and other public easements is nonexclusive and does not establish priority for their use over other franchise holders, permit holders or the City or the County. All work conducted in street rights-of-way or public easements must be covered by a permit issued by the City, County or other appropriate authority. With the exception of any emergency repairs necessary to restore service or to protect the public, all work shall be permitted prior to the start of construction.

The Contractor shall call the E&DS to initiate a request for a permit to make a cut in any
public right-of-way or easement for areas within the City of Round Rock. When outside the City, a call shall be required to the County Engineer Office of the county in which the Work is to be done or TxDOT, if appropriate, in order to request a permit.

1805.7 Cuts in Unaccepted Public Right of Way

If cuts are made in the streets after the curb and gutter or final base lift is in place, the repairs shall be made in accordance with the Specifications. Once a street has been paved, no cuts will be allowed. The Inspector shall be notified a minimum of 24 hours prior to repairs being undertaken. Repairs made without proper notification of the Inspector shall be unacceptable and are subject to removal and replacement.

End
SECTION 1806
FINAL ACCEPTANCE

1806.1 Substantial Completion
Substantial Completion shall be defined as the date when, in the opinion of the Owner/Developer or the Consulting Engineer, the Work is sufficiently complete in accordance with the Contract Documents that the City can occupy or utilize the Work for its intended purpose. The Consulting Engineer shall prepare and forward to the Inspector a letter declaring Substantial Completion and indicating outstanding items.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

1806.2 Final Inspection
Within four (4) working days of the date when the Consulting Engineer presented the Inspector with a Written Notice that the Work was substantially completed and the Inspector concurs, the Inspector will schedule a review of the Work with the Contractor and Consulting Engineer and the Consulting Engineer will prepare a Report of the Private Development Inspection (punchlist) for the Owner/Developer with copies provided for the Inspector, the Contractor and the Construction Supervisor. This form will include:

Any remaining items discovered not in compliance with Construction Documents; or other items required for the issuance of the Final Acceptance Letter.

Work that is shown on the Contract Documents as “Temporary Construction” will not be accepted by the City of Round Rock unless prior approval for the Work has been previously secured from the E&DS.

The Inspector will review and sign the Report of Private Development Inspection when all items entered are completed. A meeting for the Final Inspection may then be scheduled by the Inspector at a time convenient to the Owner and the City Engineer, as outlined in Section 1806.3.

The issuance of the Report of Private Development Inspection shall not excuse the Owner/Developer from requiring the Contractor to perform all the work required by the Contract Documents regardless of the time of discovery.

1806.3 Acceptance by the City of Round Rock
A meeting for the Final Inspection will be on the site of the Work, at a time, which is mutually agreeable between the City Engineer, the Consulting Engineer and the Owner/Developer. The Consulting Engineer will also invite:

1. The Contractor and sub-contractors, as appropriate,
2. The Inspector
3. The Street and Drainage Division of the Transportation Services Department, if the Work is located within the City,
4. The County Representative, as appropriate,
5. The Water and Wastewater Utility of the City.
6. The TxDOT representative, as appropriate.

   An Acceptance Letter will be initiated by the City Engineer for locations within the City. If all items required are completed and in proper order the City will initiate the Acceptance Letter. A Certificate of Occupancy will not be issued for any unit until a Final Acceptance Letter has been issued.

1806.4 Guarantee Against Defective Work

   The Owner/Developer and the Contractor shall warrant the Work for a period of one year from the date of City Acceptance of the completed Work, unless the period is extended by mutual agreement between the City and the Owner/Developer or the Contractor, as described below. This warranty shall provide for the correction of any and all defective materials, workmanship (including utility backfill) and/or design inadequacies, which may be discovered within the warranty period. The Owner/Developer shall correct or cause the Contractor to correct at his own expense, such defects no later than 30 calendar days after receipt of a Written Notice from the City of such defects. If the Owner or the Contractor fail or refuse to correct such defects within the 30 calendar day period or fail to provide adequate assurances that such work will be completed within a reasonable time thereafter, the City of Round Rock may correct, or cause to be corrected, any such defects at the expense of the warranty bond.

   If in the opinion of the City Engineer it is desirable to extend the warranty period for questionable work rather than requiring the Contractor to remove and replace such work, the warranty period may be lengthened to an extended period of time as agreed to by the Owner/Developer and/or the Contractor.

1806.5 Warranty Bonds

   The Owner/Developer shall execute or require the Contractor to execute a Maintenance Bond or Bonds in a total sum of 10% of the final construction value, as agreed by the City Engineer preceding Final Acceptance. The Maintenance Bond or Bonds will guarantee, the Work as specified in Section 1806.4. The Maintenance Bond or Bonds shall be made for the benefit of the City. The subdivision or development will not be accepted by the City until such bonds are furnished, approved and accepted by the City Engineer.

   The Surety Company underwriting the bonds shall be acceptable if it is included on the latest list of companies holding certificates of authority from the Secretary of the Treasury of the United States and is licensed to write such bonds in the State of Texas.

1806.6 Warranty Period

   After the Acceptance of the completed Work, including street and drainage work, is issued, the completed Work will be monitored by the Inspector. If failures, defects and/or damage appear in the Work, the Owner/Developer or the Contractor will be notified of the need for corrective action as required in Sections 1804.2 and 1806.4. End
SECTION 1807
MISCELLANEOUS

1807.1 Venue
In the event of any suit at law or in equity involving the Work, venue shall be in Williamson County, Texas, and the laws of the State of Texas shall apply to the interpretation and enforcement of the Contract Documents.

1807.2 Cumulative Remedies
The rights and remedies available to the parties are not to be construed in any way as a limitation of any rights or remedies available to any or all of them which are otherwise imposed or available by laws or regulation, by special warranty or guarantees or by other provisions of the Contract Documents, and the provisions of this paragraph will be as effective as if repeated specifically in the Contract Documents in connection with each particular duty, obligation, right and remedy to which they apply.

1807.3 Severability
If any word, phrase, clause, sentence or provision of the Contract Documents, or the application of same to any person or set of circumstances is for any reason held to be unconstitutional, invalid or unenforceable, that finding shall only effect such word, phrase, clause, sentence or provision and such finding shall not effect the remaining provisions of the Contract Documents; and all provisions of the Contract Documents are declared to be severable for this purpose.

End
Part 1: General

1.1 Section Includes

A. Prefabricated custom-designed light duty stainless steel bar gratings.

B. Miscellaneous installation hardware and accessories.

1.2 References

A. ASTM A-666 Stainless Steel Strip

B. ASTM A-269 Stainless Steel Tubing

C. ASTM A-967 Standard for Chemical Passivation for Stainless Steel

D. ANSI/NAAMM- MBG-531-09 Metal Bar Grating Manual

1.3 Action Submittals

A. Product Data: The contractor shall submit the manufacturer’s catalog pages including load tables, anchor details and standard installation details.

B. Shop drawings: The contractor shall submit for approval shop drawings for the fabrication and erection of all gratings, based on construction drawings of current issue. Include plans, elevations, and details of sections and connections as required. Show type and location of all fasteners. Grates are to meet ADA accessibility standards with a maximum grate slot opening of 1/4-inch.

C. Samples of Grating and Anchorage system shall be submitted for approval.

1.4 Quality Assurance

A. Manufacturer Qualification: A company specializing in the manufacture of metal bar gratings with not less than 10 years of documented experience.

B. Fabrication tolerances shall be in accordance with applicable provisions and recommendations of ANSI/NAAMM 531-09 Metal Bar Grating Manual.

Part 2: Products

2.1 Source Requirements:

Design is based upon use of gratings as manufactured by Hendrick Architectural Products, and terminology used herein may include reference to the specific performance or product of this manufacturer. Contractor may submit alternative manufacturers if proper support materials and
backup are provided to demonstrate the manufacturer meets the qualifications and the product is an equal or superior product.

2.2 Manufacturers:

Manufacture: Hendrick Architectural Products, Carbondale, PA, or approved equal
email: sales@hendrickarchproducts.com, phone: 877-840-0881, fax: 570-282-1506

2.3 Manufactured Units:

A. Fabrication: Fabricated using Profile Bar wires and U-clip supports from 304 or 316 stainless material. Sections to be supplied in lengths as needed with opening area as required and 0 degree deflection. Corners grates will be mitered and banded. Grating shall include hidden mounting tabs as required.

B. Design Criteria:

1. Loading: Grating Products shall be designed and manufactured to meet the live load conditions of 300 lbs/ Sq Ft with maximum deflection of 1/8” for the clear spans shown on the drawings. Bearing bar depth shall be as shown on the contract drawings or as recommended by the manufacturer to meet the loading requirements, clear span conditions and maximum deflections specified.

C. Materials: Bearing bars and banding are per ASTM A-666 Stainless Steel Strip - Alloy 304 or 316 and Stainless Steel Tube Cross Bars are type ASTM A-269 Stainless Steel Tubing Alloy 304 or 316.

D. Fabrication Tolerances shall be in accordance with ANSI/NAAMM MBG 531-09 Metal Bar Grating Manual.

E. Finish: Gratings shall be a matte non-directional finish unless otherwise specified.

2.4 Accessories:

Provide appropriate fasteners for type, grade, and class required for the approved anchorage system.

Part 3: Execution

3.1 Field Verification: Take field measurements prior to preparation of final shop drawings and fabrication where required to ensure proper fitting of the work.

3.2 Installation

A. Prior to grating installation, contractor shall inspect supports for correct alignment and conditions for proper attachment and support of the gratings. Any inconsistencies between contract drawings and supporting structure deemed detrimental to grating placement shall be reported in writing to the architect or owner’s agent prior to placement.
B. Install grating in accordance with shop drawings and standard installation clearances as recommended by ANSI/NAAMM MBG-531-09 Metal Bar Grating Manual.

3.3 Grating Attachment: Use approved attachment system and fasteners to secure grating to supporting members as shown on plans.

END OF SECTION
SPECIAL PROVISIONS TO CITY STANDARD TECHNICAL SPECIFICATIONS

These Special Provisions serve to modify, add to, and/or delete from City of Round Rock Standard Technical Specifications incorporated into this Project Manual as applicable to this project. Any item, paragraph, article of work contained therein, unless specifically modified, added to or deleted herein shall apply, where applicable.

MODIFICATION NOTES

1. Delete all "Measurement" and “Payment” Sections from all City of Round Rock Standard Technical Specifications, Special Provisions thereof, and Special Specifications required to perform the work, and replace with:

   This item will not be measured for separate payment and the cost for this item shall be included in the Lump Sum Bid for the project.
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